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The Public Lighting Tables of the American Meter Company will be found in the page advertisement of that Company.

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BRIEFLY TOLD.

DOLLAR GAS FOR PHILADELPHIA.—The long-threatened has come at last, and Philadelphia is to have the benefit of dollar gas, the result of the action of both branches of the local legislative government, which action received the speedy assent of Mayor Stuart, who signed the measure on the morning of January 8th. During the long discussion of the measure, which had been under consideration in a practical way by the authorities for something over six months, many queer points were brought out and many odd reasons advanced why the amended rate should be put at the figure suggested by the particular party who favored the said figure. Of course, much fanciful trash has been aired, and the political buncombe indulged in was simply immeasurable, nevertheless, the net result should be satisfactory to all concerned. At one time it looked that the figure which would be named would be $1.25, as that rate had the backing of the financial authorities of the city, who feared that a greater concession would involve a curtailment of revenue which would be seriously felt by the city, but the prolonged and open discussion of the matter, in which sifting many pertinent figures respecting cost of manufacture and distribution were brought out, resulted in a decision to take the bull by the horns and put the price at the lowest rate named. The Select Council vote approving the ordinance, which originated in the Common Council, was practically unanimous, the only dissenting voice out of 24 voting being that of Councilman Clay, who held that the city could not at the present time afford to manufacture and distribute gas at the dollar rate without causing a deficit which would have to be made up by increased taxation, "and there," concluded Mr. Clay, "the non-consumer will suffer." The Mayor, however, in giving his reasons for signing the ordinance, evidently thinks the ground on which Mr. Clay stands is not solid, for he says: "After the most careful investigation and consideration of the whole matter the Select and Common Councils, which have a most intimate acquaintance with and knowledge of all questions relating to the city's finances, know of all her obligations which must be met this year, and of the resources from which to meet them, have decided that the city can furnish gas at $1 per 1,000 cubic feet, without affecting finances or creating a deficit, and if this be the case the people of Philadelphia are entitled to the benefits of any reduction which it is possible to make. I have, therefore, immediately approved the ordinance." Were it not for the fact that Mayor Stuart is well known as a staid man, one might be forgiven for thinking he was poking fun at Councils when he remarks that these bodies "have a most intimate acquaintance with and knowledge of all questions relating to the city's finances," but whether so or not, the clever chief executive takes the Councils at their word and saves himself with a good, solid application of that renowned conjunction "if." We imagine there is much of an experiment in this attempt at selling gas in Philadelphia at $1 per 1,000, in so far as the receipts from that sales' scale are to exceed the expenditures; but it would appear that under an economical management—a management, however, that must not incline in any sense towards parsimony—both ends should meet under the new rate, nor should there be any undue stress felt in the operation. Presuming that the average candle power of the gas distributed in Philadelphia is equal to 22, the dollar charge is no cheaper than the $1.25 rate in New York City, where the average illuminating value of the gas supplied by the four Companies in the city proper—the Consolidated, Equitable, Mutual and Standard—is not less than 25½ candles, and where the Companies are subject to a tax on State and municipal accounts that amounts in the total to perhaps 12½ cents per 1,000 cubic feet. Possibly, this tax is somewhat over-stated, but we have no other guide than that of estimate to inform us, and we are certain in any event we are not much out of the way, when every species of "taxation" is considered to which the Companies are liable. The trial at Philadelphia will be watched by the fraternity at large with interest, and the devotees of the faith who insist that all quasi-public functions shall be exercised by the

municipal authority will, it may be taken for granted, also contemplate with concern the progress of the Philadelphia bantling. The adoption of the dollar rate will not be general, at least for the present, in the city, since a portion of the territory is supplied by the Northern Liberties Gas Company, which charges $1.50 per 1,000. The only way in which the Company can be absorbed is by purchase under acts which apply to it especially, although one-half of the representation on its Board of Directors (12 in number) is named by the city. The district which the Company supplies is virtually all built up, and it really has no growth in a gas supplying sense; and it does not seem possible that it can afford to sell gas at $1 (its annual output is something less than 100,000,000 cubic feet) and live. However, this is a matter for consideration in the future; in fact, the Company has already relegated the question of determining whether or not it can sell gas at the $1 rate, to a special committee of its Directors, and it seems to be only a question of time under the circumstances when the city must succeed to the ownership of the Northern Liberties plant. In taking leave of the subject it may be interesting to give a *resume* of the gas rates in Philadelphia since 1865:

Period.	Rate per 1,000.
Jan., 1865, to Feb., 1868	$3.00
Feb., 1868, to Aug., 1868	2.40
Aug., 1868, to Feb., 1870	2.55
Feb., 1870, to March, 1876	2.30
Mar., 1876, to March, 1880	2.15
Mar., 1880, to Oct., 1882	2.00
Oct., 1882, to July, 1884	1.90
July, 1884, to April, 1885	1.70
April, 1885, to April, 1887	1.60
April, 1887, to Jan. 9, 1894	1.50

COMMITTEE OF ARRANGEMENTS, WESTERN GAS ASSOCIATION.—Mr. E. H. Jenkins, President of the Western Gas Association, just before the close of the annual meeting last May, in Chicago, named the following Committee of Arrangements for the meeting this year, which is to be held in Cleveland: Messrs. M. S. Greenough, D. R. Warmington, C. R. Faben, Jr., Irvin Butterworth and Joseph R. Light. Since then President Jenkins, acting with the consent of the executives, has added another name to the Committee, that of Mr. C. M. Higgins of this city.

THE AMENDED DECISION OF THE MASSACHUSETTS COMMISSION.—The result of the rehearing of the Chelsea gas rate case is given in our item columns, and under the terms thereof the Company is privileged to charge $1.70 per thousand cubic feet instead of $1.65 per 1,000, as under the original decision of the Commissioners, from which the Company appealed. Under the vote of the Commission, the Company is also permitted to charge a penalty—which, we presume, means the collection of the gross charge now ruling at $1.80 per 1,000—in all cases where the bills are not paid on or before the 25th day of the month in which the same are rendered. While this discount time seems to be stretched to the very utmost limit, it still shows that the Commission recognized the force of the Company's plea to be permitted to hold a corrective check over those who are unduly laggard in settling their accounts.

NOTES.—Elsewhere we note the explosion, in the works of the New York Oxygen Company, of a cylinder that was being charged by the employees of the establishment, which resulted in the killing of one man and severe injuries to two others.* The disaster was due to the negligence of the men, who were so engrossed in conversation that they failed to observe the gauges which were recording the pressures attained. In connection with this we may note that on December 6th, 1893, a man named Eagan received injuries that resulted in his death on the following day, from the explosion of a cylinder that had been shipped by this Company to Albany, per the People's Line Steamboat Company. Eagan was a freight handler at the Company's storehouse in Albany, and at the time of the explosion was engaged in moving the cylinder from the dock to the storehouse. The Coroner's jury that investigated Eagan's death severely censured the Oxygen Company for failing to mark the cylinders so as to indicate there was danger in the "free" handling of them.—Early this month the employees of the Government gas works at West Point, N. Y., went on strike, because of a refusal to grant them fewer working hours. They had been paid $50 per month and were worked in 12 hour shifts. The Commandant filled their places from those on the enlisted rolls.—The present management of the Cumberland (Md.) Gas Light Company is as follows: President, H. Schwartzwelder; Treasurer, Webster Bruce; Supt. Robert Miller.

*The death o one of the injured has since been reported.

The Gases "Inclosed" in Coal Dust.

[A paper read by Dr. T. Phillips Bedson before the Chemical Section of the British Association.]

The investigations of Professor von Meyer and of Mr. W. J. Thomas have made us familiar with the fact that coal contains occluded or inclosed gases, and with the general composition of the gases yielded by different varieties of coal. These gases consist, as a rule, of mixtures of carbon dioxide, oxygen, nitrogen and marsh gas. In some cases Prof. von Meyer observed certain varieties of weathered coal to contain, in addition to marsh gas, some olefine hydrocarbons, and also denser members of the paraffine series of hydrocarbons, and, further, the gases obtained by Mr. Thomas from cannel and jet were also found to contain similar hydrocarbons.

In a paper read some five or six years ago before the North of England Institute of Mining and Mechanical Engineers, I gave an account of the results of experiments made by applying to coal dust Thomas's method of extracting the gases from coal. These experiments demonstrated that the coal dust under examination, when heated at 100° C. in vacuo for several hours, yielded from 0.5 to 0.8 of its volume of gas. The gas obtained in this manner proved on analysis to contain carbon dioxide, oxygen, nitrogen, some olefines and hydrocarbons of the paraffine series. In analyzing these gases, I was, by reason of the lack of suitable laboratory accommodation, compelled to use the apparatus, etc., devised by Hempel, which, while admirably adapted for technical purposes, leaves much to be wished for in determining the nature and amount of the combustible gas left after removal, by absorbents, of carbon dioxide, oxygen, and olefines. Still, the results obtained showed conclusively that the combustible gas left after the absorption of the gases named was not simply marsh gas.

In determining the nature of this combustible gas, a measured volume of the residue left after the removal of the above mentioned gases was mixed with oxygen, and the mixture exploded. From the volume of carbon dioxide produced, the contraction resulting from the explosion, the volume of oxygen used in the combustion, and the volume of nitrogen present, the proportion of combustible gas present was determined; and, assuming it to be a paraffine hydrocarbon, its probable composition was calculated by the aid of the following equation:

$$C_n H_{2n+2} + (3n + 1) O = n CO_2 + n + 1 (H_2O).$$

From which it is seen that 2 volumes of $C_n H_{2n+2}$ would produce $2n$ volumes of CO_2, give a contraction of $(n + 3)$ volumes, and would require $(3n + 1)$ volumes of oxygen. The values found for "n" from the data provided by the explosions and the above relationships indicated the undoubted presence of higher members of the paraffine series; the values for "n" found for the gases from one sample of the dust being 2.78, and 2.42 in another case.

The coal dust with which these experiments were made was that collected on the screens at the Ryhope Colliery, in the county of Durham; and the investigation was undertaken with the hope of finding an explanation of the observation frequently made at this colliery that the cloud of dust produced in screening this special coal would often fire at the lamps used for lighting the screen, and in this manner produce a species of explosion.

Since the publication of these results, I have repeated the examination of this dust, and in the analysis of the gases have employed more exact and refined methods, using for that purpose the apparatus devised by the late Professor Dittmar. Further, in extracting the gases, I attempted to effect a species of fractionation of the combustible constituents by performing the extraction at different temperatures. For this purpose some 670 grammes of the dust were placed in a bottle and attached to the mercury pump; and after the air had been completely removed, the coal dust was heated by means of a water bath for some 20 days at 30° C. The gas produced was then drawn off and measured. The temperature was raised to 50° C., which was maintained for 10 days, and in this way a second quantity of gas was obtained. A third extraction was made by heating at 60° for another 10 days; a fourth, by heating at 60° to 80° C. for 7 days; and finally a fifth, by heating at 100° C. for some 9 hours.

In this way the following volumes of gas were obtained:

First extraction	(30° C.)	100.9	c.c.	at normal temp.	and pres.
Second "	(50° C.)	160.6	"	"	"
Third "	(60° C.)	116.3	"	"	"
Fourth "	(60-80° C.)	286.0	"	"	"
Fifth "	(100. C)	89.5	"	"	"
		753.3			

This volume represents 112.4 c.c. of gas at normal temperature and pressure for every 100 grammes of coal dust.

The following table gives the results of the analysis of the several samples of gas:

	I.	II.	III.	IV.	V.
Carbon dioxide.....	5.77	8.34	12.12	27.35	20.80
Oxygen.....	9.33	7.31	5.35	0.56	4.16
Carbon monoxide....	....	....	....	1.68	2.34
Olefines ($C_n H_{2n}$)....	....	0.39	0.77	2.14	4.74
Paraffines ($C_n H_{m+2}$)	3.16	4.95	9.39	31.86	29.80
Nitrogen.....	81.60	79.01	72.37	35.70	38.16
	99.86	100.00	100.00	99.29	100.00
Values for n in formula $C_n H_{2n+2}$.... =	2.1	2.2	2.1	2.3	2.8

The changes to be observed in the composition of these gases given off at different temperatures are the gradual increase in the proportion of carbon dioxide and a diminution in the proportion of oxygen. This does not obtain with the gases produced at the highest temperature; and that is doubtless due to the fact that at this stage it was necessary to dismount the apparatus, by which the dust was brought into contact with the air. It will be further noted that, while some combustible gas is given off at 30° C., the proportion increases with rise in the temperature of the bath, the greater portion coming off between 80° and 100° C., at which temperature the olefines and carbon monoxide make their appearance. The nature of the paraffine hydrocarbons, as shown by the value for "n" in the formula $C_n H_{2n+2}$, does not appear to suffer much change until at 100°, when the value corresponds very nearly to propane (C_3H_8). Although the analysis of a mixture of such hydrocarbons does not enable us to determine the nature of the components, still there is in the above values for "n" a sufficient indication that the lighter gases of this series are the first to come away when the dust is heated in vacuo.

In this connection the question naturally arises: What is the nature of the gases inclosed in the coal from which this dust is produced? The solution of this question has been attempted by one of my students—Mr. W. McConnell, Jr.—who has examined the coal taken fresh from the same seam (the Hutton seam, Ryhope Colliery); and the results may be stated briefly as follows: 100 grammes of coal heated in vacuo to 100° C. give 818 c.c. of gas, at normal temperature and pressure, of the following composition:

	Volume.
Carbon dioxide.....	0.7
Oxygen.....	9.4
Carbon monoxide.....	0.1
Olefines.....	0 0
Marsh gas.....	16.6
Nitrogen.....	73 0
	99.8

The paraffine hydrocarbon is here stated to be marsh gas, as the results of the analysis indicated this to be the case. The coal, after the gases had been extracted, was reduced to a fine powder, and the crushed coal again heated at 100° C. in an exhausted vessel attached to the air pump. In this manner, from 208 grammes of the crushed coal, 109 c.c. of gas at normal temperature and pressure were obtained, the analysis of which proved it to have the following composition:

	Volume.
Carbon dioxide.....	0.85
Oxygen.....	6.95
Carbon monoxide.....	trace
Olefines.....	1.10
Paraffines ($C_n H_{2n+2}$).....	17.90
Nitrogen.....	73.20
	100.0

The results of the determination of the composition of the paraffine give a value of 2.08 for "n;" showing the existence here of combustible gases similar to those obtained from the dust collected in the screens.

Further, Mr. McConnell has found that, after heating the coal in vacuo at temperatures as high as 180° C., until it ceased to give off any gas, the coal, on crushing to a powder and heating again under reduced pressure at 100°, gave a further quantity of gas, which contained 39.7 per cent. of paraffine hydrocarbons, the results of the combustion of which show the presence of some of the higher members of the paraffine series.

During the past two years Mr. McConnell has been engaged in the chemical laboratory of the Durham College of Science, in the examination of the gases "inclosed" in different coal dusts produced in the working of coal raised in the Northumberland and Durham coal fields. The detailed results of this investigation will be published shortly. I may, however, state that some of the dusts examined have been found to yield mixtures of carbon dioxide, oxygen, and nitrogen only. The coal from which these dusts were produced gave mixtures of a similar composition. Other varieties of dust contained a small quantity of combustible gas in addition; while a third class was found to resemble the dust from the Ryhope Colliery, with the nature of the gases from which I have already dealt, and the chief point of interest in which is the existence among the combustible gases of such hydrocarbons as ethane and propane. The coals from which this third class of dusts are obtained have been proved to give occluded gases similar in composition to the gas obtained from the Ryhope coal; the combustible constituent being marsh gas only. Further, these coals themselves, after the occluded gases had been removed by heating in vacuo at 100° C., gave, on crushing and heating the powdered coal at 100° C. in vacuo, a further quantity of gas containing some of the higher members of the paraffine series of hydrocarbons.

These results have an interest beyond the demonstration of the fact that the denser hydrocarbons are more firmly held by the coal substance than the lighter marsh gas; and that in the working of the coal the reduction to a fine powder, such as coal dust, must, by free exposure to the air, allow ample opportunity for a ready diffusion of the marsh gas, the denser hydrocarbons being retained by the particles of coal. Again, the existence of such inclosed gases in coal dust show that, in considering the part played by coal dust in forming explosive mixtures with air, we may have to deal with a variety of dust which might readily yield such hydrocarbons as those found in the gases inclosed in the dusts examined by Mr. McConnell and myself; for these gases differ from marsh gas not merely in the proportion required to form an explosive mixture with air. Thus, while 1 volume of marsh gas would require 10 volumes of air for its complete combustion, 1 volume of the hydrocarbons found in the Ryhope coal dust would require 23 volumes of air; or, in other words, while 9.3 per cent. of marsh gas is required to form the most explosive mixture with air, about 4 per cent. only of the combustible gas obtained from the Ryhope coal dust would be required. But the difference between marsh gas and its next homologues is seen again in the temperature required to ignite such explosive mixtures; for it has been recently shown by Victor Meyer that the temperature of ignition of explosive mixtures of oxygen and ethane is lower than that of marsh gas and oxygen.

These facts point to the ready inflammability and the sensitiveness of dusts containing such hydrocarbons. This conclusion is borne out by the ignition of the coal dust on the screens at the Ryhope Colliery—a fact which led me originally to investigate this subject; and, further, the Austrian Firedamp Commission have, from their experiments with coal dust, been led to the conclusion that the sensitiveness of dusts increases with the proportion of easily inflammable hydrocarbons, especially with the amount of ethane liberated at 100° C., and with the dryness of the dust.

There are doubtless other factors which contribute to the ready inflammability and sensitiveness of a coal dust, and one can readily understand how this would be contributed to by the fineness of subdivision, and again by the air which the coal may absorb by long continued exposure in an air current.

Electricity in 1876 and in 1893.

By Elihu Thomson, in *Engineering Magazine*.

Over one hundred years ago Tiberius Cavallo wrote in his introduction to "A Complete Treatise on Electricity" as follows: "Discoveries crowded upon discoveries, improvements upon improvements, and the science ever since that time went on with so rapid a course and is now spreading so amazingly fast, that it seems as if the subject would be soon exhausted, and electricians arrive at an end of their researches; but, however, the *ne plus ultra* is, in all probability, as yet at a great distance, and the young electrician has a vast field before him, highly deserving his attention, and promising further discoveries, perhaps equally, or more important than those already made."

This was before the voltaic battery became known, before Davy experimented with it and produced the electric arc between carbon points, before metals were deposited in electrolysis, before the effects of electric currents on magnetism was discovered, before anything was known of the extensive fields of electro-magnetic and magneto-electric induction, before the telegraph, the telephone, the electric light, the electric motor, the electric railway, the art of electric metal working, and indeed before

everything which now marks electrical science as of such great importance in our time.

I have quoted the passage above as aptly expressing a thought which has doubtless in these later years arisen in many minds. It might well have been written in the present year of the World's Columbian Exposition, in view of the exemplification there made of the great progress in electrical arts during the period since the Centennial, 17 years ago. No similar period in the world's history has in any art shown so rapid development, so extensive and refined scientific study and experiment, so active invention, so varied application, such care and perfection in manufacture, as has taken place in the electrical field within the period mentioned.

It can be truly said that as a department of applied science and engineering, electricity has taken an important place only within the past 10 or 12 years. I do not forget that before the Centennial we had the telegraphic engineer, with his knowledge of batteries, lines, relays, sounders, etc.—a sufficient equipment for his work which was then the most important electrical application.

I do not neglect the cable engineer, with his more refined and delicate methods, due to the somewhat different conditions required to be met in the construction and operation of submarine lines. Electro-metallurgy, including electroplating and electrotyping, had already become of great utility when the Centennial year opened. But 17 years ago there were no dynamos in regular operation for electric lighting in the country, although a few machines of the Gramme and Alliance types were used abroad. Special forms of dynamo machines had been designed for electro metallurgy, and a number of them were in use, but installed only a short time prior to 1876. Small magneto machines had been employed for a number of years previously as substitutes for primary batteries in exploding fuses for blasting and torpedo service. Electric motors, hardly worthy of the name, were here and there operated at great cost from primary batteries, but they were of insignificant power, and resembled the old designs which figured so largely in catalogues and collections of philosophical apparatus—instructive enough in their way, but of no practical value.

What then was comprised in such electrical exhibits as were found at the Centennial exhibition in Philadelphia? Living there, and working in the electrical field, I remember that I possessed a lively mental sense of the ultimate vast utility of electrical forces which caused me to employ the opportunities afforded for study of such exhibits as from a practical or scientific standpoint showed distinct advances. There were in the main building a number of such exhibits as telegraphic apparatus and systems of signaling, electric clocks, burglar alarms and the like. In the class of philosophical instruments were the usual electric models for educational purposes. Electric key action was found applied to organs and automatic playing of the same. In Machinery Hall were to be found a few crude electric motors run by expensive and noisome primary batteries. Such motors were of but small power, and belonged to the old types, with electro magnets and bar armatures successively attracted or repelled. The application of dynamo electric machines to electroplating, then in itself quite a novelty, was represented by Weston machines of fair size. In these machines some of the principles of modern self-exciting dynamos were found, but the armatures were of the old style polar pattern with a single winding terminating in the usual pair of plates called a commutator.

But we need not further concern ourselves with these exhibits. They gave but small indication of the future of electrical progress. There was nothing in them to indicate or suggest that the world was on the eve of great advances so soon to be made.

There were, however, two exhibits in Machinery Hall of great interest to electricians as showing types of electrical machinery which in various modified forms were soon to work revolutions in lighting and transmission of power. These two exhibits were of the Gramme and Wallace machines. Neither was remarkable for floor space covered, but notwithstanding their modest extent, and the fact that they were sandwiched in between exhibits of entirely different class and widely separated one from the other, there was that in each of them which could not fail to be of deep interest to an electrical worker. The Gramme machine itself had become known in the United States through descriptions in scientific journals, and there had been two or three machines imported into the country. Two of these I had the opportunity of inspecting a year or two before. Another Gramme machine—built at Cornell University, if I remember rightly—was sent as an exhibit to the Centennial exhibition. This was probably the first dynamo of the kind built in the United States.

In the Gramme space itself could be seen a small belt-driven dynamo, giving current for the working of a single arc lamp in its circuit, series working being unknown at the time. In this space also there was an arrangement of circuit whereby one machine driven by the belt as a generator, furnished current through some 20 or 30 feet of wire to a second similar machine, which then ran as a motor. This was in turn belted to a small centrifugal pump which produced a small cataract of water. Experiments were also made from time to time in the heating and melting of wires by the current generated by the machines on exhibition. Special coarsely-wound low-potential Gramme dynamos for electroplating were amongst the interesting features. I remember the feeling of admiration—I might also say exultation—with which I viewed this most unique exhibit. I also remember the enthusiasm of the attendant, whose voice held firmly to its French, and musically rolled off the catalogue of the capabilities of the Gramme machine, "*la lumiere electrique, la galvanoplastie, le transport de force motrice, la telegraphie,*" etc.

I need not remind the technical reader that the Gramme machines were the first dynamos of the true modern type constructed—the armature iron being circular in outline and preserving its relation to the magnetic field while rotating, and the winding thereon being continuous, with leads taken at intervals to a commutator of many segments. The result was a smooth unbroken current resembling that from batteries. While in these machines the core was a ring and the wire was wound over and through the same, the subsequently developed drum type differed from it only in the disposition of the closed armature winding all on the outside of the ring core instead of through its center.

The exhibit of Mr. William Wallace was unique in showing a number of different types or forms of dynamo, while the Gramme machines were substantially alike in pattern. The Wallace machines furnished current for single arc lamps, for plating baths, and were reversed and run as motors. This exhibit was very suggestive of types and forms which afterward came into general use, and fortunately the machines themselves were preserved and sent to the World's Fair in the present year, a retrospect as it were of the Centennial exhibit. Historically considered, such early models are now invaluable. Space does not permit any detailed reference to them. Some of them were used, as were the Gramme machines, for furnishing current to work large reflector lamps similar to search lights, mounted on the roof of Machinery Hall, on occasions of evening celebration, with fireworks and other displays.

The Centennial will be remembered in the history of electrical progress on account of the fact that the telephone of Alexander Graham Bell became then for the first time known as an accomplished fact. It spoke with a small voice, it is true, at the Centennial Exhibition, but the echo of that voice was heard over the civilized world. The telephone had been invented just in time to date its birth from 1876. Dr. Elisha Gray, who was close upon Bell in the invention of the telephone itself, was exhibiting his harmonic telegraph, a very ingenious multiple telegraph, but the chief interest soon centered on the instrument that could talk. With the advent of the speaking telephone there seemed to come about a general awakening to the capabilities of electricity in practical work. It prepared the public mind for the coming of new wonders. It attracted attention to other electrical enterprises and to a large extent wiped out the factor of conservatism in relation thereto. Indeed, the telephone had scarcely begun to be used practically before the announcement of the invention of the Jablochkoff candle drew attention to the field of electric lighting, and in 1878 the Avenue and Place de l'Opera, lighted by electric candles, constituted one of the great achievements of the Paris Exposition year. The Jablochkoff candle did not, however, realize expectations; it was too costly, and soon gave place to ordinary arc lamps run in series. Much pioneer work in this field was done in this country by Mr. Charles F. Brush, of Cleveland, who in 1879 had as many as 16 arc lamps running in series from one of his well known dynamos. A few other inventors were almost equally early in this work.

It was toward the close of 1879 that Thomas A. Edison succeeded in accomplishing the task which he had undertaken and upon which he had been at work for a year or two. This was the invention of a small electric lamp giving a light of about the same candle power as a gas jet, and capable of being run in multiple with many others, without requiring too large a current or too frequent renewals of the lamp. Such a lamp to be commercially successful needed to be of low first cost, economical of power, and easily reproduced in large numbers. No one, unless he has been engaged in similar undertakings, can begin to realize the amount of effort, self sacrifice and hard work which must have been required not only to perfect the lamp itself and the details of its manufacture, but to provide suitable generators, regulators, distributing systems, mains, safety devices, and the other things which go to make complete the electrical equipment of a lighting installation, a revolution

in lighting means and methods. That Mr. Edison and his able assistants undertook and accomplished this work, the records of the numerous inventions in this field would be sufficient evidence, did we not have the fact of the actual accomplishment as a matter of engineering history.

It would be beyond the scope of the present paper to trace the history of the innumerable developments in the electrical field brought about by the effort and genius of a great army of workers, both here and abroad, between the year 1876 and the present. It must not be forgotten, either, that, aside from the great engineering triumphs which are from their practical benefits sufficiently prominent, electrical science, purely as a science, has expanded and progressed apace.

The advance, though a rapid one, has been sufficiently gradual to allow us to note the process as more of evolution than revolution. The great exhibitions held within the period between 1876 and 1893 have embodied more and more electrical arts and productions. Add to these the specially electrical exhibitions—as in Paris (1881), Philadelphia (1884), and Frankfort (1891)—and the growth becomes evidently a gradual unfolding. It was natural, then, not only that the World's Fair of this year should have been characterized by progress in all arts, but that it should have become more distinctively electrical than any preceding international display. It is to be doubted, however, if many were prepared to find that such dependence on the work of the electrical engineer would be shown.

Whether we regard the lighting of the vast areas and spaces in and around the great structures in Jackson Park, or the transportation by rail or water within its boundaries, or the distribution of power for various purposes, it was through the agency of electricity that these objects were attained. In fact, the great bulk of the steam power developed was to give motion to the dynamos for furnishing current for all the various uses to which, in these days, electricity has been applied. It is certainly no exaggeration to say that the vast amount of mechanical power developed and used at the World's Fair was mostly used for electrical purposes or transmitted electrically for its ultimate use. A vast area in the Mechanic Arts Building, covered with engines and dynamos driven thereby, directly adjoined the boiler houses and formed for the time, as it were, the most gigantic electric station ever installed. From it was sent out current for several thousands of arc lights, for from 50,000 to 100,000 incandescent lights, for innumerable electric motors working elevators, driving machinery of all kinds, ventilating, for charging storage batteries, for electric welding, forging, heating and other uses.

At the Centennial in 1876 no perceptible fraction of the power was electrically used. At the World's Fair it had become almost wholly electrical. The arrangement of the great Corliss engine at the Centennial was in the Machinery Building, and by a complex system of gears and belts the power was transmitted and delivered to the long lines of shafting extending each way from this central power source. This was a limitation of service arising directly out of the absence of electrical transmission. At the World's Fair, on the other hand, power could be delivered anywhere by the use of electric motors, and the moving machinery was not therefore practically restricted to a building in which a steam engine was at hand.

In 1876 arc lights were a curiosity and but rarely seen. In 1893 their use for illumination of streets and large spaces is almost universal. Never has there been, however, any greater display of arc lighting than in the present year at the World's Fair. The whole of Jackson Park was dotted over with these miniature suns at night, and the interiors lighted. Under the roof of the Manufactures and Liberal Arts Building were five large coronas comprising many arc lamps each, a unique display in itself and an economical arrangement as well. About 2,000 arc lights, if I mistake not, were employed in lighting the gigantic structure throughout. The great search lights, with their 60-inch mirrors reflecting the light from specially large arcs in their foci, were a striking feature of the illuminations, and these artificial sunbeams were of an intensity never before approached.

The whole art of lighting by electric incandescence has come into existence since 1876. Incandescent lamps can now be made of such uniformity of voltage and energy consumption as even to dispense with any need of photometric measurement, and indeed to require no testing or sorting after manufacture. Such lamps may consume about 3½ watts per candle and have a useful economical life of over 1,000 hours of service. An achievement like this means attention to many small details, and the doing of delicate work on a large scale. Astonishing it is to find that frequently in such work, what was formerly a delicate laboratory manipulation becomes everyday workroom practice; and here constant practice of delicate operations by even ordinary labor results in almost perfection.

The larger part of the incandescent lighting of the World's Fair—and the little bulbs were everywhere used and useful—was carried out on the alternating current plan so commonly employed in cities and towns where the electric station must be at a considerable distance from the mass of consumers. Huge dynamos in the Mechanic Arts Building supplied the alternating current at high pressure in mains leading to the transformers, located in receptacles in the ground, from the secondary circuits of which the low pressure currents were fed to the lamps connected thereto.

At the time of the Centennial alternating currents were known—and dynamos yielding such currents were known, being among the earliest invented—but the transformer was unknown. The nearest approach to it was the induction coil for shocks or medical use and the Rhumkorff coil. Soon after the invention of the telephone, however, the induction coil, modified and used in conjunction with carbon transmitters, enormously increased the distance over which speech could be successfully transmitted, and has led in 1893 to the regular communication by telephone over distances more than a thousand miles, while such is the delicacy and fidelity of transmission that it is not necessary to speak much above a whisper at New York or Boston to be heard in the receiver at Chicago.

The transformer or modified induction coil has in like manner rendered possible the economical transmission of electric energy to great distances, as the working of low voltage incandescent lamps at miles of distance from the supply station. Otherwise the line losses and excessive cost of mains would in such cases forbid the use of direct supply. The perfection to which this useful apparatus, the transformer, has been brought by careful work, may be judged from the fact that it often has an efficiency between 97 and 98 per cent. at full load. It is a simple affair of copper wire and sheet iron, apparently, but it has required much study and experiment to bring it to the present state of perfection. There is little or no opportunity for further advance. The very great expansion of incandescent lighting both by the direct supply systems and transformer systems during late years is sure to continue at an increasing rate in the future until it includes a large proportion of the lighting done in cities and towns.

[To be concluded.]

The Electric Exhibit at the World's Fair, Chicago.

The American Correspondent of the *Journal of Gas Lighting* has this to say of his impressions respecting the electric show at the recent World's Fair:

That the exhibition just closed at Chicago was the grandest affair in the way of an exposition which the world has ever seen, or is likely to see in the near future, is generally conceded; nor is the general consensus of opinion questioned even by the most captious critics. As there were were many cities looking for the honor of holding this Columbian Exhibition, it is but natural many carping critics would appear; but they could not stem the general current of opinion if they would. The "Fair" was conceived on such grand lines, and the actual production in iron, wood and staff was such a noble exemplification of that conception, that the critics could do naught but stand still and admire. The "Court of Honor"—than which there could be no nobler or grander combination of architectural skill and landscape designing—backed up by the natural beauty of the Lake, will ever remain in the memory of those who were fortunate enough to visit Chicago this summer, as a scene unequalled in the world's history of expositions.

One can say all this, and emphasize it by varied repetition, and yet unfortunately it must be added that there was little within those spacious grounds calling for technical consideration in the pages of the *Journal*. Why this was so need not now be enlarged upon, as this aspect of the affair has already been treated. Suffice it for present purposes to say that, in the language of the street gamin, "Gas was not in it."

As, however, the readers of the *Journal* desire to keep abreast of the knowledge of the day in things electrical as well as gaseous, I may again take up this portion of the exhibits, at the same time saying that, were one to consider the electric exhibit in detail, it would require space beyond that which could justly be devoted to this brilliant, imponderable, subtle subject. Rather must the matter be dealt with in a general way; and doing so will, I think, fill all the requirements of the case.

In a previous article I spoke in tones of disappointment of my first visit to the Electric Building, and a more careful study of this portion did not entirely remove my first impressions, though the four months that elapsed between the two visits did much to improve the general ap-

pearance of the electric show. It probably is not too much to say that the general lighting of the Exposition was a grander and more brilliant exemplification of the adaptability of the electric light than anything seen in the building especially devoted to this purpose. On this theme I am anxious to speak with caution, as I am likely to be classed as a member of the "disgruntled gas industry" as one whose words are actuated by bitter disappointment and spleen, rather than by cool and calm reasoning. But still I can but confirm my previously expressed opinion to the effect that the electric exhibits were not commensurate with the space they occupied and the money expended on them.

It should, however, be borne in mind that the Electricity Building was not devoted entirely to the electric lighting industry, but took in the more comprehensive exhibit of all electric matters—telephone, telegraph, and so forth. The building covered an area 345 feet by 690 feet, and cost about $400,000. The fact that the exhibits therein were supposed to include all branches of the electric business led to the introduction of many booths, the pertinency of which had to be reasoned out, and sometimes not with signal success. Thus, electric instruments being in order, some makers thereof included with their exhibit of such matters philosophical and surgical instruments. The latter in many cases predominated, to the confusion of the beholder. This, while not a grievous error, added fuel to the thought that much of the space in the building might have been better utilized by showing the adaptability of electricity to the necessities of mankind and its usefulness in lightening man's daily tasks.

As would naturally have been expected, the largest exhibits in this section were by the General Electric Company and the Westinghouse Company; and there was here much to admire. The General Electric Company's exhibits were mainly grouped around the tower of light; and one very interesting section of this Company's show was that devoted to the display of incandescent lamps. Here were to be found 2,500 specimens, all differing one from the other; and this statement gives a good idea of the fancy colored and shaped lamps shown. There were ordinary lamps of different candle power, and others made of varying voltages. There were lamps for the so-called municipal system, which means incandescent, long-distance street lighting; and there were miniature lamps of many hues and varying brilliancy. There were also special lamps of odd and fantastic designs. Again, one found examples of lamps in the several stages of manufacture, from the straight tube to the finished lamp. There was also an exhibit of fibrous vegetable material used by Edison in his experimental search after a perfect substance from which to make his carbons. Near by was one of Edison's first dynamos, built early in 1880, and used for two years at Menlo Park. It was then taken to the lamp factory at Harrisburg, where it was on duty till removed to take its place at the Fair. This section was made further interesting by the display of a model of the 3-wire system on a basis calculated for 8,640 lamps.

On the opposite side of the tower was the same Company's exhibit of electricity as applied to tram cars, which seemed to be fairly complete. Cars and trucks of various kinds were shown; also car motors and generators. Here also was an electric derrick, fitted out with an 8-ton motor, and having also a magnetic hoist. I also noted a freight truck, for handling goods in factories, fitted with two 15-horse power motors. Near by was the arc light plant of the General Electric Company—a combination, so to speak, of the useful and ornamental. This was not only an exhibition plant, but the lights given by the machines were used partly for lighting the buildings, the balance for individual exhibitors. The motive power was a 150-kilowatt Edison motor of 220 volts, connected by friction coupling to the driving shaft, from which the nine dynamos of varying sizes were belted.

Not far off was an exhibit of Thomson-Houston apparatus, particularly alternating incandescent appliances. There was here shown a Thomson-Houston alternator directly coupled to a M'Intosh and Seymour engine of 350-horse power, the capacity of the dynamo being 5,000 lamps of 16-candle power. There were also many other alternators shown; and, of course, there was a large line of station appliances as well as transformers of all sizes. The display of much of Professor Tompson's experimental apparatus added interest to this exhibit.

The General Electric Company also had a large space devoted to the exhibition of mining and power transmission apparatus. The adaptability of electricity for driving such machines was here shown in many ways, and must have been of particular interest to the mining engineer. The same Company had also a combined direct current generator and engine—the latter of the Edison marine type, triple expansion, the speed 100 revolutions and the capacity rated at 1,200-horse power. Two 400-kilowatt generators were connected with it—one on each side.

At the power house of the Intramural Railway, which, of course, was the elevated railway within the Exhibition grounds, the General Electric Company had a power generator of 750 kilowatt capacity, connected with an Erie triple expansion marine engine.

It may truly and creditably be said that the better part of the Westinghouse Company's exhibit was the plant used for the lighting of the grounds and buildings. The apparatus here involved, which was designed on great lines, made a very interesting exhibit. The alternators stand out prominently, as this Company make a specialty of this class of apparatus. The plant was made up of 12 alternating generators, each of 10,000 16 candle lamp capacity, six of them directly connected with Westinghouse vertical engines. There were also direct current machines for arc lighting and power purposes. The alternators ran at a voltage of 2,000; the pressure being reduced by the transformer to about 100 volts—the working pressure.

The lighting of the building showed considerable skill on the part of the engineers in charge. The arc light, of course, was used very lavishly—thus in the Liberal Arts Building there were arc light chandeliers of 65 and 75 feet in diameter, which means (it need hardly be said) large amounts of light and enormous power to maintain them, but certainly the effect was very good. The arc light was supplemented in its work by the incandescent; and in many cases the latter was artistically arranged, combining utility and beauty. In addition to this, what might be called the practical exhibit in the Machinery Hall, the Westinghouse Company occupied a large space in the Electricity Building, where they had an interesting exhibit of railway machinery, generators, motors, cars, and appliances for use in connection with same. Here was shown a Kodak of 270 horse power, directly connected with a Westinghouse compound engine. The display here of railway appliances was very large. There was also a very interesting exhibit of the Shallenberger electric meter. There might also have been found many arc machines, and a large display of transformers, of both the step up and step-down type. This Company also showed a 400-horse power multipolar generator; and, as may be expected, a host of other appliances too numerous to mention, including mining apparatus.

Passing now to other exhibits, there was an excellent display of arc machines in the space allotted to the Brush Company. The great novelty here was the 125-light arc machine. The machine has four poles, and the armature is specially constructed to withstand the high voltage. The dynamo was directly coupled to a Bullock engine, built at Chicago, of the Willans type; the engine and dynamo occupying a floor space only 4 feet by 11 feet, which certainly gives a high capacity per unit of floor area. The dynamo was designed to give 6,250 volts at 525 revolutions. This machine was very interesting as indicating a possible step in wire economy, involved in distributing light, though possibly this was of more theoretical than practical value, as the high voltage would propably entail more risk than many electric engineers would care to father, in our crowded cities. The Brush Company have, however, always taken the lead in large arc machines. While other companies have kept the size of the machines down to 50 lights, with very few exceptions, the Brush Company have felt at liberty to run up to 65 arcs on one machine. This gives a possible economy in copper, as fewer circuits are involved. However, when all the practical aspects of the case are considered, it is fair to say that 125 arc circuits will, in all probability, not be very soon adopted. The exhibit was very interesting as indicating the possibilities of machine building in this direction.

The same Company also showed a large line of other arc machines as well as alternators. The effect of the display was increased by a very pretty pavilion, the interior of which was finely decorated; and, being lighted by reflected incandescent light, the effect was striking and unique.

The Western Electric Company had two displays, one for service in connection with the lighting of a portion of the grounds and buildings, and the other for show. For the former purpose they used ten 50-light machines, so arranged that they could be used to run at varying amperage. The Company also had, in the Electricity Building, two 50-light machines and two 200-horse power generators. They had also a pavilion—a model of an Egyptian temple—wherein very unique effects were produced by the use of the incandescent light and colored glass.

The General Incandescent Arc Light Company had a display of arc lights, fed from an incandescent circuit of 110 volts. This Company work particularly in the direction of pretty and artistic lamps, and they made a commendable showing. The lamps were generally run two in a series. The Standard Electric Company had a display of arc light machines of 1,200, 1,600 and 2,000 candle power. The Thomson-Houston Carbon Company showed, in various forms, the different kinds of carbons made by them; and the same may be said of several other carbon companies. Siemens Halske had a display of transformers, motors and incandescent lamps in the Electricity Building. The lamps were

of varying size and color. Schonburg and Sohne had a very complete display of insulators, and they managed to make this commonplace affair of sufficient interest to attract the visitor's eye. The Fort Wayne Electric Company had a good exhibit of arc machines of all sizes and different amperes. The Mather Company made a fine show of dynamos and motors; and with them was found the new Novak incandescent lamp. This is the lamp which does not require a vacuum, the globe being filled with a gas. It is thus supposed to avoid the patent of the Edison Company.

There was a small exhibit of heating by electricity, where one could see iron kettles and small cooking utensils heated in this way; but it would be safe to say the exhibit did not frighten many gas men. It was certainly expected that more would be done in this direction; but perhaps it was realized that nature was against electricity in this particular case.

While there were, doubtless, throughout the exhibition many machines of particular interest to the electric engineer, the memory of which will bear him company for many years, it may be safely asserted that the general layman and laywoman, so to speak, will remember electricity in connection with the World's Fair, not for this or that dynamo or generator, but for the beautiful display made by the electric fountains. There have been electric fountains displayed in other fairs, but nothing equal to those shown at Chicago. The effect was certainly grand. The volume of water, and the quantity of electric current at the command of the operator, were enormous, and were used to produce most beautiful effects. The Grand Geyser threw a stream nearly 150 high. Each fountain had in its caisson or operating chamber 19 arc lights of 90 amperes each. While the fountains were grander than anything before attempted, they were worked on the same general plan as their predecessors—that is, a very strong beam of light was thrown from beneath along the axis of the water jet. The lamps, of course, were in a caisson or chamber under the fountain, and the color effects were produced by the interposition of screens of colored glass. These latter were arranged very much on the plan of a Japanese umbrella. Each fountain took its water supply from a 24 inch main, under about 100 pounds pressure, the total water consumption being at the rate of more than 20,000,000 gallons during the day. Obviously, it was too expensive to run these fountains very long; but certainly, while they were in operation, the effect of the changing and blending lights, and the varying volumes of water, were grand and unique; and this will outlive most other recollections of the Chicago Fair.

Coal in Utah.

Mr. D. McGuire, in an article describing Utah's coal resources, says that there has been no accurate survey of the exact amount of coal lands in Utah, but the region in which the coal measures exist run from San Juan county in the south, to the north line of Bearhobe county, in the northeastern part of the territory. The earliest coal mining was carried on at Coalville, in Swamp county, where in the 50's the people of Sulphoke city burned coal for blacksmith's use. Upon the entry of the Union Pacific Railroad these mines were opened and worked upon an extensive scale, as the measures are thick, the ground dry and the coal good. In the vicinity of Coalville, Summit county, there exist several localities from which coal is being extracted in considerable quantities, the chief of which is Chalk Creek, but this is some distance from the railroad. Although the coal is excellent and the measure thick, the output is not what it should be because the product must be hauled by teams to Coalville or Wanship for shipment to Grass Creek. Of late years a company was organized known as the Home Coal Company, of which R. C. Chamber, of Salt Lake City, is President. This company has made extensive improvements and the output of the Church mine is considerable, the bulk of which is disposed of in Pork City, Utah, and in the neighboring towns around Coalville. At these mines there are about 200 men employed throughout the year. Farther south, at the Castle Gate and Pleasant Valleris, about 600 men are employed throughout the year by the Union Pacific and Rio Grande Western Railroad Companies in mining coal in these places, which are situated in Emery county. The measures are very thick and easy of approach, as they are horizontally in vast table lands and work is carried on from an opening in the perpendicular face of great cliffs.

The Rio Grande Western Railway Company, at Castle Gate, has most improved methods of mining. There is at Castle Gate an electric railroad operated in the mines and this is carried into the mountains for about three miles; as the vein is almost 12 feet thick there is ample room for operating such a road. The mines there are lighted by electricity and ventilation is excellent.

From the coal produced there, coke is made in ovens at Castle Gate and the coke so produced is sold to the smelters at Sandy, Utah, and also to the foundries at Ogden and Salt Lake, although it does not produce coke skelps of such length as is obtained from Pennsylvania coal, yet it serves every purpose of the smelter and foundry.

The coal from Pleasant Valley is taken out over a short line of railroad which connects with the main line of the Rio Grande Western at Pleasant Valley. The coal mined there by the Union Pacific Railroad Company is hauled over the Rio Grande Western line to Salt Lake and Ogden. The deposits of coal in that region are extensive, and at the present rate of working the beds could not be exhausted in 50 years.

In San Pete county there are very extensive fields of bituminous coal, worked, as yet, only for local consumption. In San Juan and Grande counties there are vast quantities of coal, some of which coke very well, and as time develops the mineral wealth of that region, the coal deposits will come into market. Taken collectively the coal fields of Utah are immense, and although not of such superior quality as those of Pennsylvania, still they are good, suiting them to use in every industry of mine and factory. As railway tariffs grow less, thus permitting the establishment of many works now unprofitable through high freight, the Utah coal lands will become a most profitable investment.

Rolfson's Carbureter Attachment for Gas Engines.

United States Letters Patent, No. 498,447, were issued to Mr. Rolf J. Rolfson, of San Francisco, Cal., and following is an abstract of the inventor's specification:

This invention relates to a certain new and useful carbureter for attachment to gas engines, which consists in the arrangement of parts and details of construction as will be hereinafter more fully set forth in the drawings, described and pointed out in the specification.

The main object of the invention is to provide a device which shall be secured direct to the engine itself and form a part thereof, for the purpose of vaporizing the volatile oil fed therein, for the running of the engine, and in this manner permit the users of gas engines to dispense with the necessity of making employment of the well known carbureters for the generation of the explosive compound for the engine, the use of which carbureters being open to the serious objection that owing to the quantity of volatile liquid necessarily contained therein for generation of the explosive gas, great danger is liable to follow a back explosion from the engine.

A further object of the invention is to provide a device which, when the speed of the engine is increased or decreased, will automatically control the supply of explosive gas to the engine and that of the volatile oil from the reservoir to the carbureter, and to close the supply passage for the volatile oil in case of a back explosion from the engine occurring, in order to prevent the ignition of oil contained within the reservoir, which would follow in case no automatic check were provided for the supply pipe.

Referring to the drawings forming a part of this application, wherein similar letters of reference are used to denote corresponding parts throughout the entire specification and several views:

Figure 1 is a side elevation of a gas engine, showing the attachment secured thereto, Fig. 2 an enlarged vertical sectional view of the carbureter, Fig. 3 detail side elevation of the carbureter, and Fig. 4 cross sectional top plan view, taken on line x—x, Fig. 2.

The letter A indicates an ordinary gas engine, provided with the usual exhaust pipe A^1, for outlet of hot products of combustion and inlet pipe A^2, for admission of explosive gas to the engine, while B is the operating rod for controlling exhaust valve, which is raised and lowered through the medium of any suitable cam secured upon shaft B^1. These parts being well known in the making and working of all gas engines call for no specific description, more especially as they form no portion of the present invention.

The carbureter consists of the casing C, which is preferably constructed of glass, open at both ends, which is closed by means of metallic top and bottom plates C^1, C^2, each of which has a circular seat a cut in the face thereof and into which ends of casing C fit as shown, and the two plates are secured together and casing forced to snugly fit within seat a by means of screw bolts D. The bottom plate C^2 is cast with two downwardly extending pipes D^1, D^2, which pipes join at their bottom and terminate in the outwardly projecting pipe D^3. The pipes D^1, D^2, serve to convey the explosive gas from the vaporizing chamber E, as generated therein as hereinafter set forth, to pipe D^3, from whence it is fed to the combustion chamber of the engine through the medium of inlet pipe A^2, which is connected to outlet pipe D^3, as shown. The pipes D^1, D^2 are connected at their top by means of bridge E^1, which is pro-

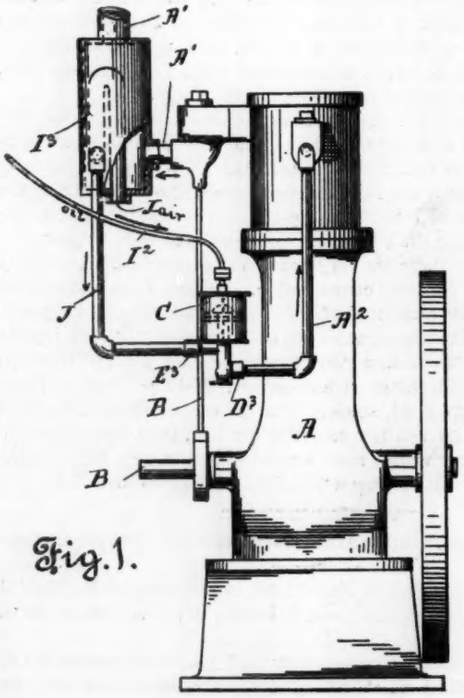

Fig. 1.

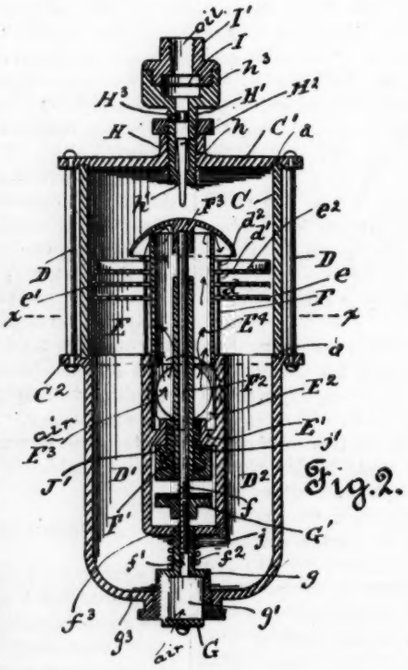

Fig. 2.

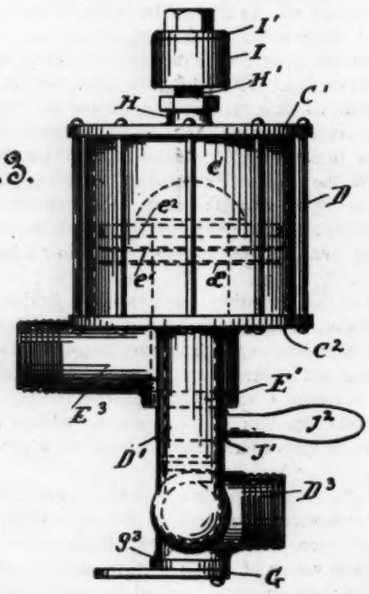

Fig. 3.

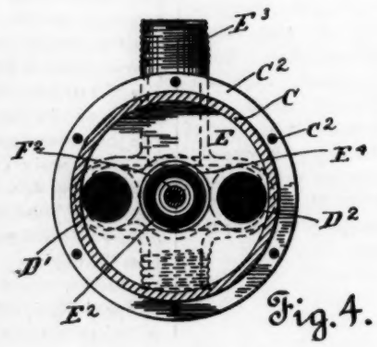

Fig. 4.

vided with the central air passageway E^2, which is intersected by means of air inlet or supply pipe E^3. This pipe may be cast integral with bottom plate or be formed separate. When formed integral it may be said to constitute a continuation of the hollow bridge, or the bridge may be cast separate from the bottom plate and made in the form of a pipe, but the inventor prefers, owing to cheapness, to cast the parts integral. Into the upper end of hollow bridge or pipe E^1, which extends through bottom plate, as shown, is secured lower end of shell E^4, which extends upwardly within the vaporizing chamber E. This shell is surrounded by a loose sleeve F, Fig. 2, which supports a perforated screen e. In the device shown he makes employment of a set of three screens e, e^1, e^2, the screen e^1 being separated from screen e by washer d, and screen e^1 from e^2 by washer d^1, while the upper or top screen e^2 is held in place and united to shell E^4 by means of collar d^2. This collar is soldered or otherwise secured to the shell and thus prevents the disarrangement of the screens during handling of the device.

Into and through the bottom of hollow connecting bridge E^1 is secured a downwardly extending sleeve F^1, which sleeve is internally screw threaded and into which is fastened an upwardly projecting hollow guide F^2, which guide extends within shell E^4, as shown in Fig. 2. Through this guide works valve stem f, the upper end of which is connected to a dome-shaped valve F^3, which closes the hollow shell E^4. The lower end of the valve stem is screwed into seat f^1, formed in sleeve f^2, which is located within passageway for the explosive gas, and projects through opening formed in pipe wall f^3. The lower end of said sleeve is provided with an enlarged head g, which closes the air vent g^1, which extends through wall g^2. The admission of air through this vent is controlled by means of slide G.

Upon the lower screw threaded portion of the valve stem f is secured the regulating collar G^1, which, by being adjusted up or down on the screw-threaded lower portion of the valve stem, serves to regulate the lift of the dome shaped valve and the inlet of volatile oil within the carbureter, as hereinafter will more fully appear.

The top plate C^1 of the carbureter is provided with a central opening h, which is surrounded by an annular internally screw threaded flange H. Into this flange is fitted an externally screw threaded hollow plug H^1, which is closed at its lower end, and through the lower end is drilled a tapering opening h^1. Within the hollow portion of the plug is fitted a tapering valve H^2, which moves up and down through the opening h^1, the taper of which corresponds with that of the valve. The taper or inclination of this valve and valve opening is cut to a mathematical scale, so that as the valve is raised by the lift of the dome shaped valve, only such a quantity of volatile oil is permitted to flow through opening h^1, as will serve to generate a certain power, that is to say, that if the lift of the dome shaped valve is regulated so as to raise a one-half distance the lift of the valve H^2 will correspond therewith, consequently the passageway of opening will likewise be limited and the quantity of oil which flows therethrough will be reduced. The hollow portion of plug H^1 has secured therein, above the extreme lift of the valve, a central perforated collar H^3, which prevents the valve moving beyond a certain distance. In case of a back explosion the valve H^2 will be forced upward until the top thereof bears against the central opening of the collar and closes or cuts off the oil passage, consequently preventing ignition of the inflammable oil.

The plug H^1 is formed with an enlarged hollow head h^3, and within the hollow portion is located a screen I, which is held in proper position by means of a screw threaded cap I^1. This cap is formed with a central opening, and the upper end of the cap is reduced so as to permit supply pipe I^2 fitting thereover. This pipe may be of rubber or any other suitable material, and serves the purpose of conveying the volatile oil from the reservoir, which may be located at any convenient point, not shown, to the oil passage.

The exhaust pipe A^1 of the engine is partly enlarged into the casing I^3, and into the same extends the fresh air pipe J, which circulates therein and passes therefrom downwardly and connects with inlet pipe E^3. As the fresh air enters this pipe it circulates within the same and is heated by the raised temperature of the casing, caused by the hot products of combustion from the engine being retained therein, and when discharged into pipe E^3 is extremely hot. This hot air passes into the hollow bridge or pipe, and from there enters the hollow shell E^4, and the suction from the engine, through pipes A^3, D^3, D^2 and D^1 causes the hot air to raise the dome-shaped valve in order to admit the hot air into the vaporizing chamber. As the hot air strikes the under face of the valve, the surface of same is raised to an extreme degree of heat, and as same is lifted it contacts with lower end of valve H^2, and raises same so as to permit the escape of oil through passageway h^1, which as it escapes into vaporizing chamber falls upon the heated surface of the dome-shaped valve, the heat of which and the retained hot air cause the oil to vaporize. As the carbureted air makes its escape from said chamber into pipes D^1 to D^3, it passes through the openings of the heated screens e, e^1, e^2, which not only serve to extract all moistures therefrom, but also effect the separation of any and all particles. The dome-shaped

valve is forced down upon its seat through the medium of the spring *j*, which surrounds the valve stem sleeve f^2, which spring is compressed during the uplift of the valve. This sleeve is raised or lowered so as to open or close the air vent g^1.

The outer face of sleeve F^1 is provided with worm threads j^1, and upon same works the worm collar J^1. This collar is provided with an outwardly extending handle J^2. As this handle is turned to either the right or left the worm collar is caused to move up or down, and as thus moved serves to lengthen or shorten the lift of the valve stem, owing to the fact that regulating collar contacts therewith. By connecting the handle J^2 with the engine governor, the same may be thrown in or out automatically by the increased or decreased speed of the engine. In case the gas flowing from the vaporizing chamber does not contain sufficient oxygen, the same may be supplied thereto by opening the vent slide *G*.

The inventor's claims are:

1. In a carbureter, the combination with the carbureting chamber, of a tapered guide passage for the volatile oil leading into said chamber, a tapered valve mounted in said guide passage and held therein by gravity, an air inlet, an exit for the carbureted air, and a valve controlling the flow through the air inlet and constructed to actuate the valve in the guide passage and thereby regulate the supply of volatile oil.

2. The combination with the carbureting chamber, of a hollow plug secured in the top of the same and having a downwardly tapered opening in its lower end and a tapered valve mounted loosely in the plug and resting normally in said opening.

3. The combination with the carbureting chamber provided with an oil inlet and an outlet for the explosive gas, of an air inlet shell or tube arranged within the said chamber, a valve to open and close said shell, a valve stem guide, a stem secured to the valve and extending through the said guide, and a spring acting on said stem to close the valve.

4. The combination with the carbureting chamber provided with an oil inlet and an outlet for the explosive gas, of an air inlet, a valve to open and close the air inlet, a valve stem guide, a stem secured to the valve and extending through the said guide, and a stop adjustably secured on the stem and adapted to impinge against the guide and thereby limit the movement of the valve.

5. The combination with the carbureting chamber having oil and air inlets, of an outlet pipe for the explosive gas, an air vent in said outlet pipe, a slide on the outer side of said vent, a valve for the air inlet, and a valve on the inner side of said vent connected with the valve for the air inlet.

6. The combination with the carbureting chamber of a hollow plug extending through the top of the same and having a tapered opening in its lower end, a valve resting normally in said opening, and a centrally perforated collar secured in the plug above the valve and constructed to limit the movement of the same.

7. The combination with the carbureting chamber, of a hollow plug extending into the top of the same, a valve located within the plug, a screen arranged transversely within the plug, a cap secured to the end of the plug and bearing on the screen to hold the same in place, and a perforated collar within the plug acting as a stop for the valve.

8. In a carbureter, the combination with the carbureting chamber having oil and air inlets and a gas outlet, of a valve in the oil inlet, a valve in the air inlet constructed to operate the oil inlet valve, a valve stem depending from the air inlet valve, a guide through which said stem passes, an adjustable collar supported by the lower end of the guide, means for adjusting said collar, and a stop on the valve stem constructed to impinge against said collar.

The inventor subsequently assigned all interest in the patents to the Union Gas Engine Company, of San Francisco.

The Use of Coal Gas for Domestic Purposes Other than Lighting.

The following very practical article is from London *Hygiene:*

This subject is one which requires consideration from many points of view. As the comparative cost of coal and gas for heating purposes is an element of importance, and as prices vary so greatly, it will be the simplest method to adopt a standard price for both, which will admit of easy calculation for the varying prices of the two fuels. Taking coal at $4.25 per ton, we get 11 pounds weight for 2 cents; and taking gas at 83 cents per 1,000 cubic feet, we get 25 cubic feet for 2 cents; 20 cubic feet of London gas (16 candles) have a theoretical heating power equal to 1 pound of good coal. So that, at the comparative prices given gas is nearly nine times the cost of coal, provided both fuels could be burned with equal economy, which is far from being the case on the small scale required for ordinary domestic use. Where the work is small and intermittent, such as cooking, bedroom fires, and bath heating, gas comes out in practice far the cheaper fuel; but where the work is fairly regular, such as the heating of ordinary living rooms by open fires, the cost of gas averages in practice about three times that of coal. Of course, by the use of warm air arrangements combined with a gas fire the cost may be reduced quite 50 per cent., and the same economy may be practiced with coal or coke, by using coke stoves, but for the fact that they are very unpopular in this country; rooms heated by air-warming arrangements being comparatively close and stuffy. This feeling is caused by the upper part of the air being warmer than that near the floor, the practical result being that in rooms heated in this manner it is difficult to keep the feet warm, even with the thickest carpet.

One of the commonest fallacies with regard to gas is the idea that a given quantity of gas burned in a common lighting burner gives less heat than if consumed in a bunsen or atmospheric burner. This is entirely a mistake. Gas, whether burned in a common lighting burner, a regenerative lamp, a bunsen or atmospheric flame, or a blowpipe or furnace, gives, if properly burned, absolutely the same quantity of heat for the same amount of gas under any and every condition, the only difference being in the concentration or the convenience of its application for any special purpose.

For instance, if a large air space has to be warmed by burning gas in it, it is a matter of absolute indifference whether we use common lighting jets, regenerative lamps, atmospheric burners, blowpipes, or blast furnaces; the result is exactly the same in each case if the air is kept in circulation. For every cubic foot of London 16-candle gas burned we get a heat of 660 units—*i.e.*, a heat which, if perfectly utilized, would raise the temperature of 660 pounds of water 1° F. In the large air space under consideration we should, with any of the methods of burning, obtain the whole of the heat in useful work; but if we wanted to melt, say, one pound of cast iron, the only method by which any useful work could be obtained would be in a blast gas furnace, where the whole of the heat can be concentrated rapidly on one spot.

This explains why, under ordinary circumstances, an atmospheric burner is so much more efficient than a lighting burner for boiling water; the heat from the atmospheric burner can be localized and concentrated on the work required, and less is lost in the surrounding air.

Having now settled a basis on which the results may be compared, and explained some of the sources of possible error, we may consider the various purposes to which gas may be advantageously applied for domestic use, and the points which require attention to prevent failure and annoyance.

Domestic Cookery.—Under ordinary circumstances the whole of the products of combustion come into the kitchen; they are in themselves free from odor and no nuisance in any way, but they may easily become a very serious annoyance if some simple points are neglected. The stench and nuisance of cooking by a coal fire are inappreciable from the simple fact that the whole goes up the chimney; if the same nuisance were to appear with gas cookery it would be intolerable in any house, and to prevent this certain points are essential. The burners must be clean, and must burn with a clear greenish-blue flame; the vessels must be clean outside; a pan used on a coal fire and then placed on a gas burner will make a suffocating smell throughout the house, owing to the tarry matters deposited on the vessel by the imperfect combustion of the coal. Pans, etc., containing fatty matter must not be allowed to boil over on the burner, as the smell of charred fat, or any animal or vegetable matter, is most offensive; for similar reasons roasting tins must never be placed above a gas flame, either in an oven or over a boiling burner. If perfect sweetness in the kitchen is required, the use of the frying pan must be prohibited, as the smell from frying is always unpleasant; it is quite unnecessary, as the work can be done far better by a gas grill. Fried food is indigestible and cheap, but the cheapness does not compensate for its indigestibility.

We now consider the cost. Taking an ordinary gas cooking range, such as is usually hired out by the gas companies, the expense depends largely on the care and supervision exercised, and to demonstrate this I will give two extreme cases, the results of which have been carefully taken, and may be depended on as being fair examples. The first is one of a small and careful household, where close supervision is constantly exercised; the other is that of a household conducted on a liberal scale, under the control of a good *chef*, where everything is done in the most perfect manner; the average may be taken between these.

"Cooking regularly for six persons and boiling water for general purposes; no fire in the house during the summer months; gas, 58 cents

per 1,000 cubic feet. Total cost of 12 months cooking, $5.64." This is extraordinarily low in cost, and is a rate which will rarely be reached; the other case is equally clear on the opposite side.

"From the 4th January, 1888, to the 2d of July, 1889, cooking for ten persons, the total gas consumption was 41,700 cubic feet, which at 58 cents per thousand cubic feet amounts to $24.18 or $5 per month. The average consumption of coals in the fire-range before using gas was 1 ton per month, costing $5."

These are actual cases in practice, not estimates; but it is quite evident that even in the latter one no actual waste of gas has been permitted, and that the furious boiling over and general burning of things by extravagant and unchecked gas consumption have not existed.

It is a curious fact that roasting, which is always a costly process before an open fire, is the cheapest process carried on by gas, as the average gas consumption per pound of meat roasted in ten different gas cooking ranges, by different makers, did not exceed 3 cubic feet of gas per pound of meat roasted, the lowest being 2 cubic feet and the highest 4½ cubic feet per pound of meat. The difference was caused almost entirely by the different sizes of the ovens used, the cost being ruled by the size of ovens rather than by the weight of meat roasted.

Boiling Water.—With gas at 25 cubic feet for 2 cents, in ordinary broad bottomed pans or kettles, the cost averages 2 cents for every 5 gallons boiled.

The cost of grilling is, taking the average of a number of tests, almost exactly double that of roasting, whereas frying, the cheapest of all methods, costs considerably less than roasting the same weight of meat, although there are no statistics available from which average results can be obtained.

It may be taken as an absolute rule, without any exception, that gas cooking can always be done in an ordinary kitchen without special ventilation and without any offensive smell, and where any exists it is a sign of either waste, dirt, or carelessness. As to its popularity, this may be estimated by the fact that one English gas company has out on hire, at the present time, over 60,000 appliances for cooking and heating, at least one half of these being for cooking purposes only.

Bath Heating by Gas.—This is a subject which requires very much more attention than has been given to it. The modern fashion of extreme speed of heating entails conditions which are not always possible, and when these are neglected or overlooked a very distinct element of danger appears. This has been proved by several fatal accidents, if they may be classed as accidents. With the best apparatus which can be made a 30 gallon bath cannot be heated by less than a consumption of 30 cubic feet of gas. This will require at least 300 cubic feet of air to consume it, and the resulting 330 cubic feet of burned air and gas will render fully 3,000 cubic feet of air totally unfit for respiration. If the heating is done in 15 minutes in a bath room 10 feet square, the whole of the air in the room becomes quite unfit for respiration in 5 minutes; and the only possible remedy is to connect the heater with reliable flue which can be absolutely depended on as being free from risk of down draught. This is by no means a simple matter in most cases, where no flue exists near the bath room, and although there are some methods by which the deficiency may be overcome, these, like many house chimneys, are not always successful, owing to local conditions and peculiarities. The only safe way to fix a rapid or instantaneous bath heater is to put the whole matter in the hands of an experienced fitter, and make him responsible for the success or failure. A man who thoroughly understands this class of work will know at once the difficulties, but, of course, such a man is not likely to be the cheapest. In the absence of an absolute guarantee from the fitter it may be taken as a rule, without any exception, that a bath heater which will heat an ordinary, full-sized bath in the usual small bath room, is unsafe if it will do the work in less than from 1½ to 2 hours, and this, for ordinary domestic use, is quite quick enough. To quote the saying of a friend, "People do not, as a rule, get dirty so quickly as to require a bath oftener than every two hours."

With regard to rapid bath heating, fashion is very well in its way, but it is not policy to risk life for the sake of fashion, when circumstances are against safety; and bearing on this question, it must be remembered that rapid heaters in which the gas is burned in ordinary illuminating flames are quite as dangerous, without a good flue, as any other form, although many makers, who should know better, assert the contrary. The rapid combustion of a large quantity of gas must of necessity remove oxygen from the air, and as a matter of fact, in a small close bath room the burner of a large rapid bath heater would remove the oxygen so rapidly from the air that it would extinguish itself, and for this reason the products of combustion must be removed. This does not apply to slow working heaters with a small rate of gas consumption, as the natural diffusion which always takes place is sufficient to render this harmless.

Gas Stoves and Fires for the Sick-room.—These to be satisfactory, require to be different to the ordinary gas fires in living rooms. In a sick-room it is necessary that the temperature shall be kept steady, the fire at times requiring to be turned very low. This, in the usual pattern of iron fret, or hollow ball fires, is not possible, as neither of these forms can be always depended on to work at less than one-half their normal power, and to make these suitable for sick-rooms it is necessary to divide the burner into two or more parts with separate taps, which is an undesirable and expensive complication liable to cause trouble in unskilled hands. We may consider that for sick-room use the following conditions must have the first attention: 1. Great range of power, down to the lowest, without risk of lighting back at the jet. 2. Comparative silence. 3. Absence of strong light. 4. The power to use bronchitis kettle or steaming arrangement when needed.

To fill the whole of these conditions it is necessary to have a fire surface of fibrous asbestos on a flat brick, the burner having much smaller holes than are necessary for the iron fret or hollow fires. Where the temperature of the air of the room is important, the fire should, for economy's sake, have an air-warming arrangement combined with it, and for steaming, either a boiling burner attached as a trivet to the fire, or a separate boiling burner placed on the hearth, the latter being, perhaps, the best, as the kettle can be got well forward into the room. An exceeding good substitute for a bronchitis kettle is a blanket or heavy bath towel wetted and hung before the fire. Except in affections of the lungs, warm air in a bedroom is objectionable to most, and a simple source of radiant heat is by far the most agreeable; all air warming arrangements have the same objection as hot water pipes, they cause a feeling of stuffiness which is intensely disagreeable to many people.

With regard to noise, all atmospheric flames cause more or less sound, and unfortunately all taps have the same defect; some are excessively noisy, and the sound, travelling along the tube, appears to come from the gas burner, exaggerating a defect which is in itself not usually great. The best method to reduce the sound is to use a good gas governor on the main supply so as to prevent excessive pressure.

Many extraordinary statements as to the cost of gas fires have been made, not one of these being based on any actual results, or giving any basis to calculate from. The mistake is that the calculations have been made from the air space to be heated. The absorption of heat by the air varies enormously according to the moisture held in suspension, but under any circumstances it may be quite ignored as a basis on which calculations must be made for heating rooms of different shapes. The heat is almost entirely expended on heating the walls of a room; they appear to have an unlimited capacity for the absorption of heat, and the calculation must be made from the wall surface, the following rules being the result of repeated trials on both a large and small scale under varying conditions. We will take first the cheapest possible form of gas heating, flueless stoves, and limiting the ventilation. This system is suited only for beer cellars and stores, and is given as a standard of reference for the greatest available duty for the fuel used. Rule for finding the gas consumption required to obtain any exact temperature: For every 1,200 square feet of wall surface (excluding ceilings and floors) a consumption of 1 cubic foot of gas per hour is required for every 1° F. rise of temperature. Example, a room without flue, kept close, and badly ventilated. size 30 by 30 by 10 feet high, would require a gas consumption of 20 cubic feet per hour to raise the temperature 20° F.

The figures given are for continuous heating, night and day—*i. e.*, for retaining a given temperature after it has been obtained. The actual heating up of the room and walls is a comparatively slow process, and depends on the speed required. It may be taken as a rule that for heating up a room which has been allowed to cool, at least double the consumption will be required for the first three or four hours. If the products of combustion are carried away, and the room is fairly ventilated, the gas consumption will average nearly double this, and it may be taken as a safe rule for a gas fire and warm air arrangement, that a well ventilated room will require, for every 600 square feet wall surface, cubic foot of gas per hour for every 1° F. average rise of temperature. Where a fire alone is used as a source of radiant heat, the temperature of the air varies so greatly that exact experiments are impossible, the air only becoming warm as the radiant heat is absorbed by the walls and solid contents of the room, so that it cannot be considered as an air warmer. The cost given above will apply also to living rooms, except when a gas fire is built up in an ordinary coal fire grate. This, owing to its backward position and surroundings, is a most costly luxury, and can only be adopted when expense is no object. It is a most popular

form of fire, and its use is rapidly extending, in spite of the extravagant cost; but, of course, when used in drawing-rooms for short periods the cost is a very secondary matter, as compared with convenience and absence of dirt.

With regard to condensing stoves, or "siphon" stoves as they are sometimes called, their power is very small for their size and cost, and the largest are only suited for very small rooms. It is the custom of most makers to hide the outlet for products of combustion, and this has led to a general belief that all the products of combustion are condensed. This is not the case; only the sulphur compounds and the water of combustion are condensed, and the carbonic acid escapes into the room. Its presence may readily be detected by analysis of the air, but as it is quite inert the only effect is to reduce the percentage of oxygen in the room, and to cause, to a certain extent, the close feeling which is caused by all flueless stoves. Carbonic acid evolved in the breath is known to be both offensive and dangerous in confined places, but this is only on account of the germs and volatile organic matters with which it is contaminated.

The advantages of the use of gas as a fuel are not only great, but many of them are simply unapproachable by any other fuel. In the sick room we can, not only get warmth, but we can get precisely the kind, and the quantity we require, dried or moist, convected or radiant, as needed. The warming of food, and other matters for sick room and nursery use, is simple, quick, and certain, night and day; and the disturbance of restless patients and children is avoided. In the preparation of food, the perfection of the result, and the absence of burning and waste, irrespective of the economy in labor and expense, are quite sufficient to put gas in the front rank. With proper arrangements bath heating can be done by gas in a way which is simply impossible with any other fuel. At the same time we must not expect special miracles, and those who expect a down draught in a chimney to be cured by the use of a gas fire, will always be doomed to disappointment.

Rustless Coating for Iron.

M. Octave de Rochefort-Lucay read the following paper, at a meeting of the Paris Societe d'Encouragement, on the new Bertrand process for coating with magnetic oxide and enamelling iron and iron carburets, and on a new process for tinning for cast iron.

Messrs. Barff and Bower were the first to practically coat iron, steel and cast iron with magnetic oxide, so as to form, at the cost of the metal itself, the protective layer that is obtained usually from paint, or from enamelling, etc., with a thin coating of a metal that is not oxidizable.

The Bertrand processes are more simple than those of Bower and Barff, and are based on a new discovery in chemistry, and may be stated thus: If a thin adherent film of another metal is formed on the wrought iron or on the cast iron, and this iron or cast iron, heated to 1,000°, is exposed to a current of oxidizing gas, the oxygen penetrates through the film, oxidizes the iron or the cast iron, and under these conditions magnetic oxide is the result. The formation of magnetic oxide, thus obtained, continues indefinitely, and the thickness of the coating of oxide increases according to the period of exposure to the oxidizing current, providing the temperature remains at about 1,000°.

As to the film of metal deposited in the first instance, it disappears in some obscure way, forming oxides which mingle with the magnetic oxide or volatilize according to the nature of the metal of which they are composed. M. Bertrand had then to find the best metal and the best method for depositing it on the article to be coated, and he has found that bronze, a mixture of copper and tin, gives, from a practical point of view, every satisfaction. For depositing this bronze on the wrought iron and cast iron, M. Bertrand uses electricity or wet baths, and uses sulphophenolic acid.

The following is the method adopted in the Bertrand manufactory for an oxidation:—The article is cleansed (the cleansing is not indispensable), then dipped a few moments in a bath containing a solution of sulphophenate of copper and tin. The coating of bronze being formed, the article is immediately washed with cold water and dried with sawdust. The article dried is put into a furnace. Oxide forms, and at the end of fifteen to thirty minutes (according to the articles) the article is taken out, sufficiently oxidized. The coating produced varies from $\frac{1}{10}$th to $\frac{1}{4}$th of a millimetre.

M. Bertrand uses electricity to ascertain if the coating is of sufficient and uniform thickness, and in doing so he makes use of bells. If in putting the two wires in contact with the oxidized article the bells ring, the current passes—the oxidation is insufficient; if it remains silent, the oxide formed is of sufficient practical thickness because it prevents the electric current from passing.

Process for Tinning Cast Iron.—M. Bertrand has also used sulphophenolic acid to obtain tinning on iron. He dissolves salts of tin in a mixture of water and sulphophenolic acid at the rate of 1 per cent. of tin salt, and 5 per cent. of sulphophenolic acid. In this mixture the article, which is previously cleaned, is dipped, and is at once covered with an adherent coating of tin, and afterwards by the means of rotating brushes in wire and cloth the coating of tin is polished, and a result is obtained which is both effective and cheap.

Process for Enamelling.—There are not more than two processes for enamelling cast iron. In the first, called hot, the iron, heated to a vivid red, is powdered with a flux powder (borosilicate of lead), distributed with a sieve, then it is heated, and when the flux fuses it is powdered afresh with glass more soluble, forming the glaze of the enamel. This process, the only direct enamelling, is dangerous to the operator, and even impossible for large articles, nor does it allow of decorations. The second process consists of dressing the cast iron either by three distinct and successive operations in the furnace with a kind of pottery. In the Bertrand enamelling, the article is first coated with magnetic oxide, then dipped in borosilicates of lead, colored by metallic oxides, in which is added a little pipe clay in order to give rather more body. The article thus covered cold, by dipping or with brushes, is put into the furnace; the enamel adheres and vitrifies at the usual furnace temperatures used by enamellers. By putting a coating of colored enamel with a brush on a first coat simply plain, it is possible to make any decorations desired, which may be burnt in at one operation for outdoor vases, etc. These results, due to the first oxidation with magnetic oxide, are remarkable as much for the color as for the tenacity of the enamel and its resistance to rough usage.

ITEMS OF INTEREST FROM VARIOUS LOCALITIES.

THE Ohio Gas Company, of Lima, Ohio, has leased for a term of years the entire properties of the Ashtabula (Ohio) Gas Light Company, and has installed a water gas system of the type constructed by Mr. Joseph Askins. The capacity of the plant is 125,000 cubic feet per diem, and the lighting value of the gas supplied is not less than 20 candles. Mr. P. E. Hall, Jr., the former Secretary of the Ashtabula Company, has been retained by the lessees as Manager and Superintendent.

THE people of Hyattsville, Md., are discussing the advisability of authorizing a bond issue of $25,000, the money to be devoted to the erection of a gas plant. Hyattsville is in Prince Georges county, on the Washington branch of the B. & O. Railroad, at a point 7 miles northeast of Washington, and it is likely it would give fair support to a gas company.

IT is reported that a Chicago syndicate is endeavoring to secure a franchise for the operation of a gas and electric light works at Antioch, Ills. Antioch is in Lake county, Ills., and is on the Fox river, about 52 miles northwest of Chicago. Population of the township, about 5,300.

THE gas plant at Asheville, N. C., is to be enlarged and improved this coming spring.

THE expenditures last year on the manufacturing and distributing divisions of the gas plant of the Utica (N. Y.) Gas and Electric Light Company amounted to something like 10,000, and Superintendent Pinckney is happy over the fact that the sendout for 1893 shows a gain of 7 per cent. over that for 1892.

MR. FRANK LYMAN has resigned from the Board of Directors of the Brooklyn (N. Y.) Gas Company, giving as a reason therefor his appointment as Deputy Commissioner of City Works, which department has close business relations with the Gas Company.

ON the 4th inst. a cylinder which was being charged with compressed gas on the works of the New York Oxygen Company, 366 First avenue, this city, exploded with great violence. One workman (Thomas Gregg) was instantly killed, and two others (Fred. Gardiner and John Moran) were severely injured. A local paper in discussing the accident says: "Moran was at the hydrogen compressor, engaged in charging two cylinders, which lay on a stout wooden table, with the nozzles screwed to the delivery pipes of the compressor. Gregg stood close to the table, engaged in conversation with him. It is the theory of the Company's officers that Moran forgot what he was about and let the cylinders take too big a load. The cylinders are tested for a pressure of 3,600 pounds to the square inch, and are never charged with more gas than is sufficient to give one half that pressure. To guard against overcharging

there is a safety valve which is supposed to blow off at 2,500 pounds, and a gauge, the indicator of which registers any pressure up to 3,000 pounds. To cause an accident of the nature that occurred two things are necessary: First, the safety valve must have refused to act; and, second, Moran must have paid no attention to the gauge. After the indicator marked 3,000 pounds it could go no further, so there is no telling how much of a pressure those cylinders sustained before they burst."

WE can supplement our mention of the project for the establishing of a Gas Company at Salamanca, N. Y., by saying that the Village Board has given permission to the proprietors of the natural gas company at Bradford, Pa., to pipe the town. The probability is that the line will be extended to the adjoining villages of Randolph and Little Valley.

THE Board of Gas and Electric Light Commissioners, having considered the evidence presented on the rehearing of their order putting the price of gas at Chelsea, Mass., at $1.65 per 1,000 cubic feet, have decided to permit the Company to charge $1.70 per 1,000.

JAMES BRADY, by his attorneys, Messrs. Brady & Howard, recently filed papers in a suit for $10,000 in the City Court of Baltimore, against the Consolidated Gas Company of that city. He alleges that an escape of gas, for which the Company was responsible, caused the death of his daughter Marian, at their residence, 619 East Chase street, on the night of October 11, 1893.

THE Malden and Melrose (Mass.) Gas Company has put its selling rate at $1.60 per 1,000 cubic feet—a concession of 20 cents per 1,000—the same to be in effect from the first of the month.

THE Michigan Fuel and Gas Company has been incorporated by Messrs. John C. Goodrich, Wm. A. Bercry, H. E. Emmons, Eugene Gregory and George E. Brick. It is capitalized in $1,000,000, and its purpose is to exploit in Michigan the patented gas making process devised by the celebrated Mr. Harris.

MESSRS. J. W. GRACE & CO., of New York, are arranging to put on a line of tank steamers for the purpose of transporting petroleum from Peru to the Pacific Coast, with the avowed object of underselling the Standard Company in the Coast Market. They say they will be able to sell the Peru product at $2.50 per barrel in San Francisco.

THE following are the awards made by Director Windrim in the instance of the supply of gas coal for the ensuing year to the Philadelphia gas works:

Name of Company.	Tons.	Price per Ton.
Penn Gas Coal Company	77,314	$3 69
Westmoreland Coal Company	77,314	3 69
Manor Gas Coal Company	5,000	3 68
C. B. Orcutt	23,000	3 68
Despard Gas Coal Company	15,000	3 65
Gaston Gas Coal Company	15,000	3 65
Montana Coal and Coke Company	15,000	3 65
Newburgh Orrel Coal and Coke Company	15,000	3 65

SINCE writing our mention of the amended decision of the Board of Gas and Electric Light Commissioners, in the matter of adjusting the gas rate at Chelsea, Mass., we received the following statement of the reasons which led the Board to recommend the change ordered: "The price fixed in the former vote assumed that there should be no diminution in the Company's output, and no demand for extraordinary expenditures for repairs at the works, upon which considerable sums have recently been expended, but it appeared at the hearing that the condition of the distributing plant was such that large sums must soon be spent for its improvement. The Company's recent loss by fire at the works, which has occurred since the last hearing, will also entail an increased expense for repairs. Further new evidence was introduced that owing to the reduction of the business of large manufacturing establishments since the former hearing there has been a substantial decrease in the Company's output of gas, and it is possible that such a condition may continue. It seemed clear from this new evidence and the figures presented that such a price would entail a further reduction in the rate of dividends, which has already been reduced by the Company to 5 per cent. Upon careful consideration of all the evidence the Board has considered that under the present conditions some modification of its former order is necessary to enable the Company to pursue its business for the best interests of the community in which it is placed. Voted, that the net price of gas supplied on and after January 1, 1894, to consumers of the Chelsea Gas Light Company, shall not exceed $1.70 per 1,000 cubic feet, if paid on or before the 25th day of the month in which the bill is presented." From this it will be seen that the Board also virtually recedes from its decision denying the right of the Company to maintain a gross and net rate conditioned on prompt payment. The time in which the discount is available, however, is stretched to the utmost limit.

MR. A. F. HOWES, writing to us from San Francisco, under date of January 4th, says: "In view of your mention in your issue of December 25th, of certain proceedings instituted by the Council of San Jose, California, against the San Jose Light and Power Company, I may say that a few days ago a lengthy opinion was presented to Council by City Attorney Hardy in respect of the proceedings. It will, no doubt, be remembered that the resolutions adopted by Council (it was introduced by Ald. Hogan) directed the Attorney to determine whether the city had authority to require the San Jose Light and Power Company to furnish to the Council an annual detached statement showing the name and residence of each gas rate payer, rate paid, itemized statement of expenditures for supplying gas and amount of money actually expended annually since commencing business, in the purchase, construction and maintenance respectively, of the property necessary to carry on the gas business, also, the gross receipts during the same period. Mr. Hardy cited numerous decisions on the same question, and from them advanced the opinion that under the exercise of police power municipalities have the power to establish maximum rates to be charged by water, gas, telegraph, telephone and electric light companies; that if gas or electric light companies make use of the streets in the prosecution of their business different from the use made by the general public, they cannot complain that the city should enforce its right to regulate its business in behalf of the public, if such regulation should become necessary. If it is deemed necessary to exercise this power he held that all regulation on the subject must embrace all companies furnishing artificial light. 'It may be doubted,' he said 'if the Mayor and Common Council possess the inquisitorial power to require a corporation to expose its affairs to a business rival, by filing a verified statement showing the cost of its plant, the amount annually received, and expenditures, etc.; but certainly if such power exists it should be exercised impartially in both companies engaged in artificial lighting. I am of the opinion, however, that the business of furnishing artificial light to the inhabitants of the city of San Jose is subject to municipal regulation and that a maximum price for the commodity furnished may be fixed by the Mayor and Common Council."

THE gas works at Milton, N. Y., which have been operated for some years by Mr. William Clements, under the corporate title of the Ballston Spa Gas Light Company, have been purchased by Mr. William S. Waterbury, formerly Chief Clerk in the office of the Secretary of State.

MANAGER LITTLETON, of the Quincy (Ills.) Gas Light and Coke Company, is now reaping the benefit of the main extensions and renewals made by him last summer. Dollar gas for fuel is very popular at Quincy, and Col. Steinwedell and his big lieutenant are enthusiastic over the success that has attended their pet project.

"OBSERVER" forwards the following: "At the annual meeting of the stockholders of the New Haven (Conn.) Gas Light Company, the following directors were chosen: Charles P. Ingersoll, George J. Brush, Francis Wayland, Andrew W. DeForest, E. Hayes Trowbridge, Pierce N. Welch, George D. Watrous, Robert A. Brown and T. Attwater Barnes. The Company has been enabled to continue paying its quarterly dividends of 2½ per cent., notwithstanding dull times. To keep pace with the growth of the city, the average increase in the number of consumers is about 400 in ordinary years, but it has not reached that number the year past. Some of the consumers, in an attempt to cut down household expenses, have ordered the meters taken out, deciding to depend upon kerosene oil for an illuminator for a season. Others have economized in the amount of gas they have burned. Despite these economies, the Company has steadily increased the amount of gas sold over last year, and now has about 8,500 consumers."

THE Lewiston (Me.) Company reports a good increase in the sendout for '93 as against '92. In December a net gain of 22 meters was recorded.

MUCH discontent is manifested at Passaic, N. J., over the action of the local electric light company, which has advanced the charges for an incandescent electric light service in the sum of 10 per cent. The rate for commercial arc lights was increased from $5 per lamp per month to $9.

THE Haverhill (Mass.) Common Council for 1893 signalized its going out of office by voting to lay on the table the order proposing to establish and operate on municipal account a gas and electric light plant.

WE are indebted to a correspondent for the following respecting the gas supply of Cicero, Ills.: "Cicero enjoys the advantages resulting from a good gas service at low rates. On June 2d, 1892, the Board of Trustees granted to N. A. McClary a gas franchise for the town of Cicero. The Cicero Gas Company was immediately organized, and within a year one of the best equipped gas plants in the United States was in operation, supplying a very superior gas through over 26 miles of mains, laid in Austin, Ridgeland and Oak Park. The character of the service is unsurpassed and the prices are 33⅓ per cent. lower than in the average city of 12,000 people, notwithstanding the fact that the investment is, owing to Cicero's magnificent distances, much greater than the average. The management of the Company has been liberal, and special efforts have been made to educate the community to the use of gas, not only as an illuminant but as a fuel for cooking and intermittent heating. As a result the Company already enjoys a very large patronage and is rapidly increasing its output. A high candle power smokeless gas is supplied, the cost of which, for lighting, is little if any greater than that of oil. Improved burners and devices have been introduced which increase the efficiency and lower the cost of illumination. A system of automatic lighting is shown by the Company, and it has introduced more than 500 gas ranges during the past six months, most of which are being continued in use through the winter. It has been fully demonstrated that gas as a fuel for cooking is cheaper than coal, which is proven by the cost of coal used against the cost of gas used. A complete record of all such bills is kept in convenient form at the Company's office, and is open to the investigation of any one desiring to investigate. The average of nearly 3,000 bills proves that gas as a fuel for cooking is cheaper than coal, and it goes without saying that for comfort, cleanliness, convenience and efficiency the two fuels are not to be compared. The office of the Cicero Gas Company is a handsome building erected by it for the purpose at No. 115 North Oak Park Avenue. The officers of the company are: President, N. A. McClary; Vice President, C. D. Hauk; Secretary and Treasurer, Irwin Rew; Engineer, E. E. Morrell. The works are located upon the Wisconsin Central Railroad, at Austin Park, and the system of manufacture is that known as the Rew process. The works were built and are operated by the National Gas and Water Company, 218 La Salle Street, Chicago."

WE will be pleased to publish any replies that may be received in answer to the queries propounded in the following letters:

New York, Jan. 10, 1894.

To the Editor AMERICAN GAS LIGHT JOURNAL: Will some of your readers give information in reply to the following questions: In ordinary coal gas making how often is the liquor drawn off from the hydraulic main, either partially or entirely? How much water is supplied to it per day? (Answers will, of course, have to be stated in terms per retort or per bench of x retorts, or per ton of coal carbonized.) What is the average temperature of the hydraulic main?

Yours truly, NUTCRACKER.

WE are in receipt of a handsomely illustrated paper issued by the Majestic Manufacturing Company, of St. Louis, which is one of the largest and best known stove manufacturing concerns in the Western country. The illustrations show the design of the various gas and coal ranges made by the Company, and the explanatory text is well put together. We may farther say that Mr. Charles V. Newman has taken charge of the gas range sales department of the Company, and it goes without saying that Mr. Newman will work faithfully and successfully to advance the interests of the Majestic Company.

MR. A. L. ROACH, JR., has resigned the Superintendency of the Crawfordsville (Ind.) Water and Light Company. He proposes to go into the banking business at California, Mo.

THE Acme Gas Company, of Carthage, Mo., has been incorporated. It is capitalized in $40,000.

THE commission having in charge the construction of an electric lighting plant, to be operated by the municipality of Detroit, Michigan, announces that the bids for the buildings will be opened on the 23d inst., and that the bids for the machinery, etc., will be opened on the 30th inst.

THE Cambridge, Mass., Common Council, recently adopted the following order: "That his honor, the Mayor, is hereby authorized to request the Cambridge Electric Light Company and the Cambridge Gas Light Company, respectively, to make and file with the City Clerk detailed statements of all the plant and property of said corporations, respectively, which said corporations may propose to sell to this city, if it shall complete its decision to establish a plant for the manufacture and distribution of gas or electricity, one or both, with the terms of sale proposed therefor by such statements to be in full compliance with the provisions of Section 3 of Chapter 454 of the Acts of the Legislature of Massachusetts for the year 1893, any expense therefor to be charged to incidental expenses."

ON the morning of Saturday, Jan. 6th, one of the holders of the Louisville (Ky.) Gas Company was thrown out of equilibrium by an erratic burst of wind, to the point of extinguishing a great number of lights in the West End of the city.

A SLIGHT fire at the works of the Mount Joy (Pa.) Gas Company is reported. The cause was the ignition of oil floating on the tank water of the gasholder.

JUDGE GUNSTER, of Scranton, recently listened to arguments on application for continuing the preliminary injunctions obtained by the city of Scranton, Pa., against the Scranton Gas and Water Company, and the Scranton Gas and Water Company against the city of Scranton. City Solicitor Torrey appeared for the city, and ex-Justice Alfred Hand and Attorney I. H. Burns for the Company. The matter at issue is the power of the city to pass an ordinance defining the manner in which the Company shall lay its pipes. The ordinance provides that before opening any street the Company shall obtain a permit from the Street Commissioner, and if it be a paved street, deposit a sufficient sum of money with the City Treasurer to enable the Street Commissioner to repair the pavement. The Company opened a street in violation of the ordinance, and was enjoined by the city. Another injunction enjoined the city from interfering with the Company in opening streets, which is a right said to be granted to it by its charter. Mr. Torrey made the first argument. He said that it was necessary for public safety to have regulations with regard to the opening of highways to make improvements, and that such regulations have to be general. He did not deny the charter rights of the Company, but held that the ordinance does not contravene these rights, the ordinance having been passed in conformity with the police powers granted to municipalities by the legislature. All legislation granting charter privileges, he held, has the implied reservation that the privileges are subject to reasonable police regulation. The city had to pass a general ordinance with regard to the regulations prescribed, and could not pass one for the Gas and Water Company and another for companies and individuals. The permit is required that the Street Commissioner may know what streets are being opened and in what condition they are left after the improvements are completed. Mr. Burns argued that by the terms of the Gas and Water Company's charter the city was debarred from imposing such restrictions as are set forth in its ordinance. He declared that the city had no right whatever to compel the Company to obtain a permit every time it wanted to open a street, and pay money into the city treasury to enable the Street Commissioner to do the work that its own skilled workmen could perform in a more satisfactory manner. The Company would not object to reasonable regulations, but this ordinance was not what it purported to be, a regulating ordinance, since it does not attempt to regulate. The taking out of a permit, he said, was not a regulation, for the very word permit signified the granting of a right from a superior to an inferior power. Ex-Justice Hand said that the charter of the Company gave it great powers, but they were necessary to carry out the purposes of its incorporation. If the Company fails to perform its duties in a proper manner in connection with the laying of its pipes the city might have an action against it to compel it to do so, but by its ordinance it is endeavoring to shift the responsibility of seeing that the streets are properly repaired after excavations are made by the Company, from the shoulders of the Company on to its own. The pipes have to be repaired all hours of the day and night, and it would be burdensome to compel the Company to have to seek the Street Commissioner whenever it is necessary to open a street for any purpose. Decision was reserved.

THE Iowa City (Ia.) Gas Light Company has at last managed to perfect its organization by the election of a regularly chosen Board of Directors. Mr. J. N. Coldren was chosen temporary Secretary, and Mr. D. Davis, the Company's Superintendent, is to act as Treasurer.

MR. JASON HALL WHITTIER, father of Mr. J. Porter Whittier, the well-known gas works buildings constructor, of Brooklyn, N. Y., died on the evening of the 9th inst. He was in his 64th year.

The Market for Gas Securities.

The market for city gas shares showed no signs of returning animation for the week, although Consolidated experienced an upward movement that sent the price temporarily above 127. There is, however, no stability to quotations, and buyers and sellers seem to be afraid of what each day may bring forth. Consolidated opened to-day (Friday) at 125 bid, offered at 127. That the market is in a queer condition is best shown by the doings in Consolidated on the Exchange yesterday. Only 45 shares were disposed of, still the range was 126¼ to 124⅞, with 125 bid at the close. From our best view we incline to the belief that the stock is a sale. Mutual is firm at 144, bid, ex div., and Equitable is fairly steady, at 187, bid.

Brooklyn shares show no change, but some movement toward consolidation was made in the shape of an invitation from President Orr, of the Metropolitan Company, to other Companies to send delegates to a conference to be held in the near future. Bay State recovered some of its loss, and is now bid for at 14. Chicago gas after selling up to 66⅛, opened to-day at 64⅜ to 64½. Baltimore Consolidated is at 53¼ to 53¾, and 56 is offered for Detroit first mortgage 5's. Boston United Gas, first mortgages, are quoted at 78 bid. The Montgomery (Ala.) Light Company is in a bad way, with every likelihood that the property will go into the hands of a receiver.

Gas Stocks.

Quotations by Geo. W. Close, Broker and Dealer in Gas Stocks,

16 Wall St., New York City.

January 15.

☞ All communications will receive particular attention.
☞ The following quotations are based on the par value of $100 per share.

	Capital.	Par.	Bid	Asked
Consolidated	$35,430,000	100	125	127
Central	500,000	50	90	95
" Scrip	220,000	—	—	100
Equitable	4,000,000	100	187	190
" Bonds	1,000,000	—	106	108
Harlem, Bonds	170,000	—	—	—
Metropolitan, Bonds	658,000	—	108	112
Mutual	3,500,000	100	144	147x
" Bonds	1,500,000	—	100	102
Municipal, Bonds	750,000		—	—
Northern		50	80	95
" Bonds	150,000	—	—	100
Richmond Co., S. I.	346,000	50	50	65
" Bonds	20,000	—	—	—
Standard Gas Co—				
Common Stock	5,000,000	100	—	32
Preferred	5,000,000	100	—	77
Yonkers		50	112	—
Gas Co's of Brooklyn.				
Brooklyn	2,000,000	25	110	115
Citizens	1,200,000	20	57	—
" S. F. Bonds	320,000	1000	—	101
Equity Gas Light Co	2,000,000	100	—	—
Bonds	1,000,000	—	25	40
Fulton Municipal	3,000,000	100	130	—
" Bonds	300,000		103	—
Peoples	1,000,000	10	80	—
" Bonds (7's)	368,000	—	100	—
" " (6's)	94,000	—	98	100
Metropolitan	870,000	100	—	140
" Bonds (5's)	70,000	—	100	—
Nassau	1,000,000	25	145	—
" Otfs	700,000	1000	99	100
Williamsburgh	1,000,000	50	130	—
" Bonds	1,000,000	—	107	110
Out of Town Gas Companies.				
Bay State Gas Co.—				
Stock	5,000,000	50	14	14½
Income Bonds	2,000,000	1000	40	—
Boston United Gas Co.—				
1st Series S.F. Trust	7,000,000	1000	78	—
2d " " "	3,000,000	1000	57	58
Buffalo Mutual, N. Y.	750,000	100	110	—
" Bonds	200,000	1000	95	100
Citizens, Newark	1,000,000	50	155	160
Chicago Gas Company.	25,000,000	100	64⅜	64½
Chicago Gas Light. & Coke Co.—				
G't'd Gold Bonds	7,650,000	1000	81⅛	81½
Consumers Gas Light Co., Jersey City	2,000,000	100	—	30
Bonds	600,000	1000	—	85
Cincinnati G. & C. Co.	7,000,000	100	192	—
Consumers Toronto	1,600,000	50	184½	187
Central, S. F., Cal			—	100
Capital, Sacramento, Cal			—	55
Consolidated, Balt	11,000,000	100	53½	53¾
" Bonds	6,400,000		107	107½
Citizens Gas Lt. Co., Rochester, N. Y.	500,000	—	85	101
Bonds	250,000		—	—
Detroit Gas Co.—				
1st Mortgage			56	—
East River Gas Co., Long Island City	1,000,000	100	—	—
Bonds	500,000	100	89¼	—
Equitable Gas & Fuel Co., Chicago, Bonds	2,000,000	1000	—	101
Hartford, Conn	750,000	25	120	128
Jersey City	750,000	20	190	200
Louisville, Ky	2,570,000	50	125	130

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Brotherhood Wine Co., New York City, writes: "We would not be without them if they cost twice as much."

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IS THE MOST ECONOMICAL GENERATOR IN THE WORLD, BOTH IN COST AND OPERATION.

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I build these Generators with any required capacity, from 3,000 cubic feet per hour upward. All the plants which I have built for the past four years can be seen in operation. Results are, in all cases, better than guaranteed.

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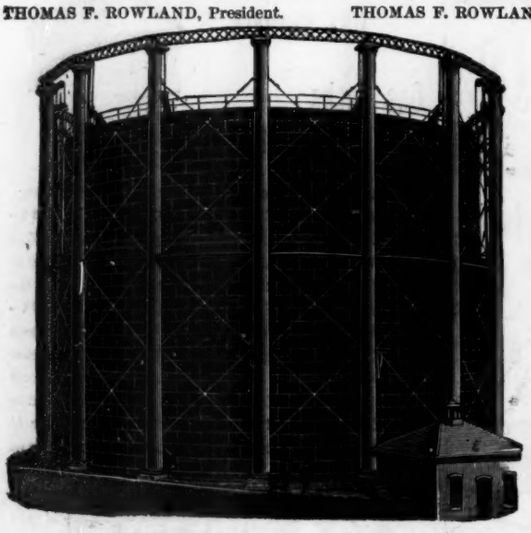

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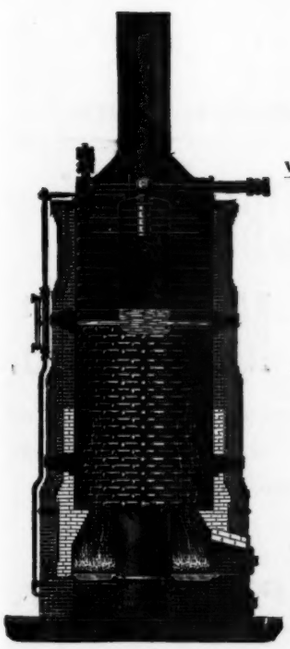

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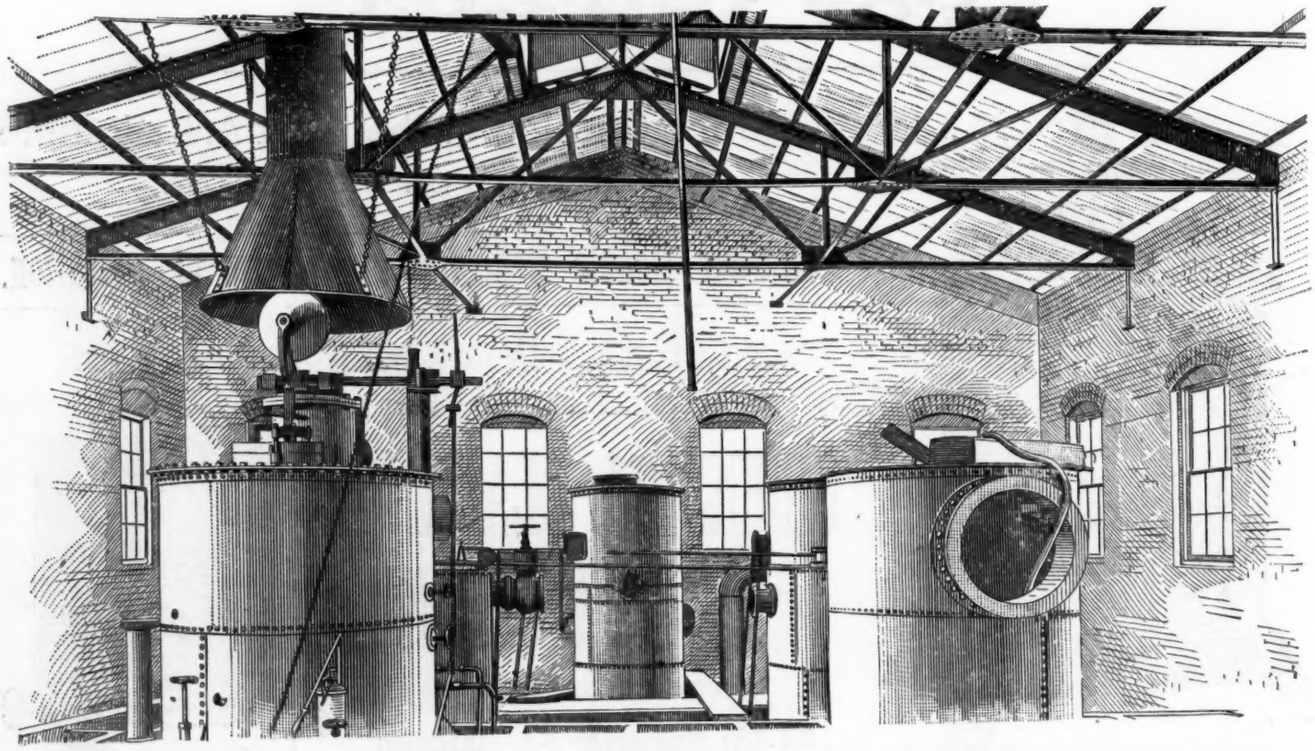

The above illustration is taken direct from a photograph, and shows the construction of an Iron Truss Roof designed and built by us for the Lynn Gas and Electric Company, at Lynn, Mass. The building is 37 feet in width by 64 feet in length, with brick side walls and an Iron Truss Roof covered with corrugated iron. A building of this kind cannot possibly take fire, as the interior appointments are such that there is little or no woodwork used about the construction of the plant, and no woodwork used about the side walls or roof.

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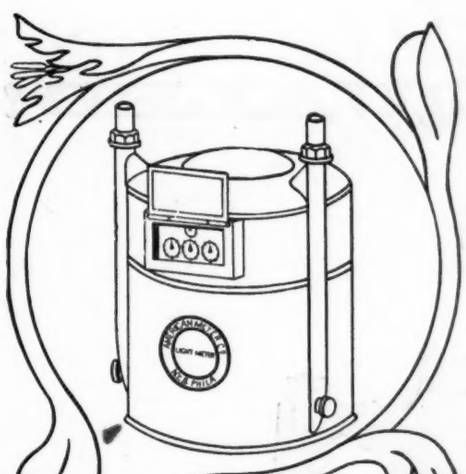

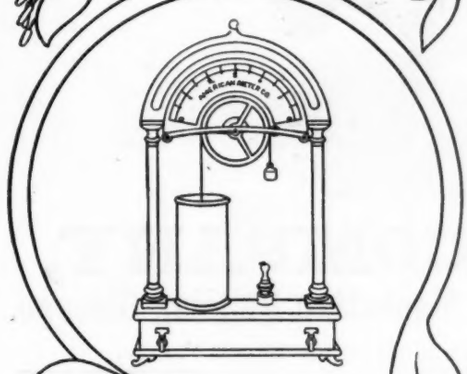

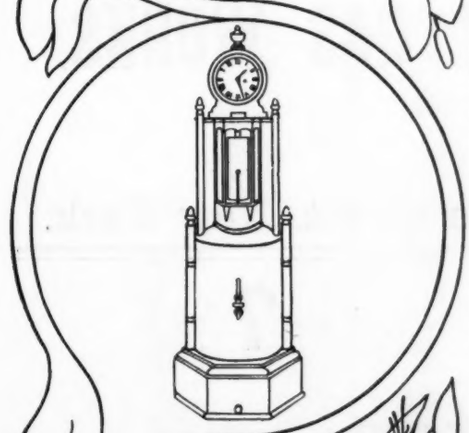

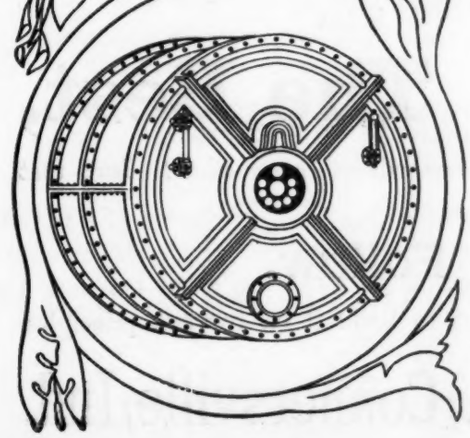

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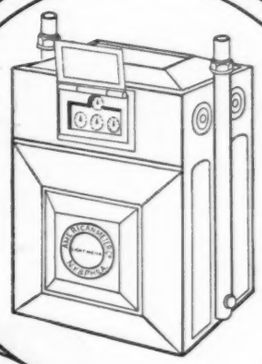
PUBLIC LIGHTING TABLE.

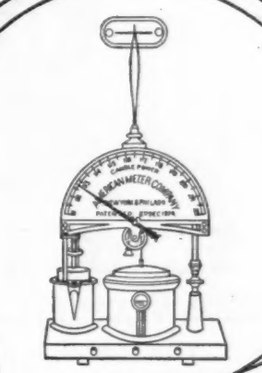
JANUARY, 1894.

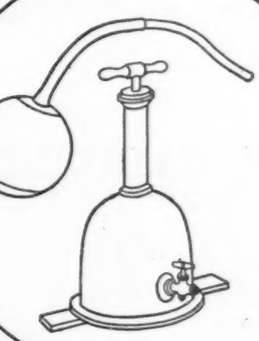
Day of Week.	Date.	Table No. 1. Following the Moon. Light.	Table No. 1. Following the Moon. Extinguish.	Table No. 2. New York City. All Night Lighting. Light.	Table No. 2. New York City. All Night Lighting. Extinguish.
				P.M.	A.M.
Mon.	1	5.20 PM	4.30 AM	4.30	6.30
Tue.	2	5.20	5.30	4.30	6.30
Wed.	3	5.20	6.20	4.30	6.30
Thu.	4	5.20	6.20	4.30	6.30
Fri.	5	5.20	6.20	4.30	6.30
Sat.	6	5.20 NM	6.20	4.30	6.30
Sun.	7	5.20	6.20	4.30	6.30
Mon.	8	5.20	6.20	4.40	6.30
Tue.	9	5.20	6.20	4.40	6.30
Wed.	10	5.20	6.20	4.40	6.30
Thu.	11	8.30	6.20	4.40	6.30
Fri.	12	9.30	6.20	4.40	6.30
Sat	13	10.30	6.20	4.40	6.30
Sun.	14	11.40 FQ	6.20	4.40	6.30
Mon.	15	1.00 AM	6.20	4.50	6.25
Tue.	16	2.10	6.20	4.50	6.25
Wed.	17	3.30	6.20	4.50	6.25
Thu.	18	4.40	6.20	4.50	6.25
Fri.	19	No L.	No L.	4.50	6.25
Sat.	20	No L.	No L.	4.50	6.25
Sun.	21	No L. FM	No L.	4.50	6.25
Mon.	22	5.40	7.30 PM	5.00	6.25
Tue.	23	5.40	8.50	5.00	6.25
Wed.	24	5.40	10.00	5.00	6.25
Thu.	25	5.40	11.10	5.00	6.25
Fri.	26	5.40	12.10 AM	5.00	6.25
Sat.	27	5.40	1.20	5.00	6.25
Sun.	28	5.40 LQ	2.20	5.00	6.25
Mon.	29	5.50	3.30	5.05	6.15
Tue.	30	5.50	4.30	5.05	6.15
Wed.	31	5.50	5.30	5.05	6.15

TOTAL HOURS LIGHTING DURING 1894.

By Table No. 1.	Hrs. Min.	By Table No. 2.	Hrs. Min.
January	244.10	January	423.20
February	195.30	February	355.25
March	206.20	March	355.35
April	169.40	April	298.50
May	162.10	May	264.50
June	135.40	June	234.25
July	146.30	July	243.45
August	162.20	August	280.25
September	174.10	September	321.15
October	211.20	October	374.30
November	221.00	November	401.40
December	245.30	December	433.45
Total	2274.20	Total	3987.45







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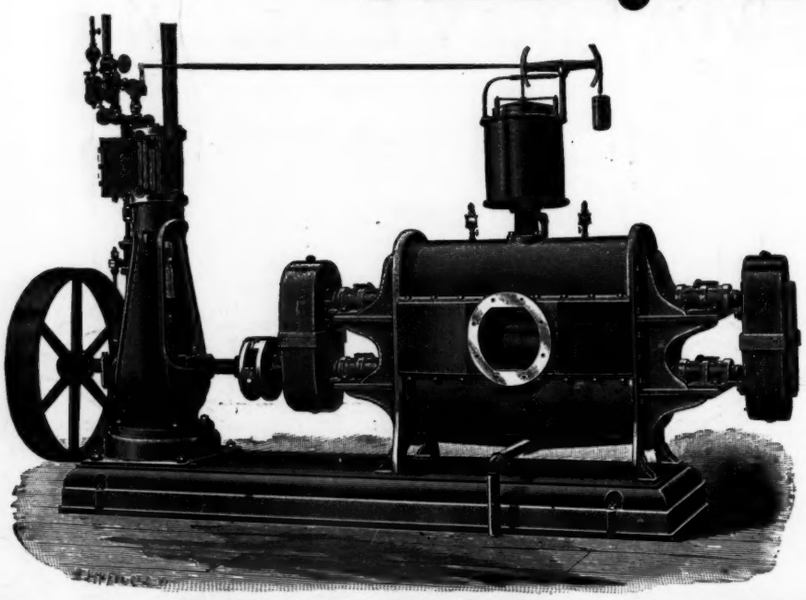

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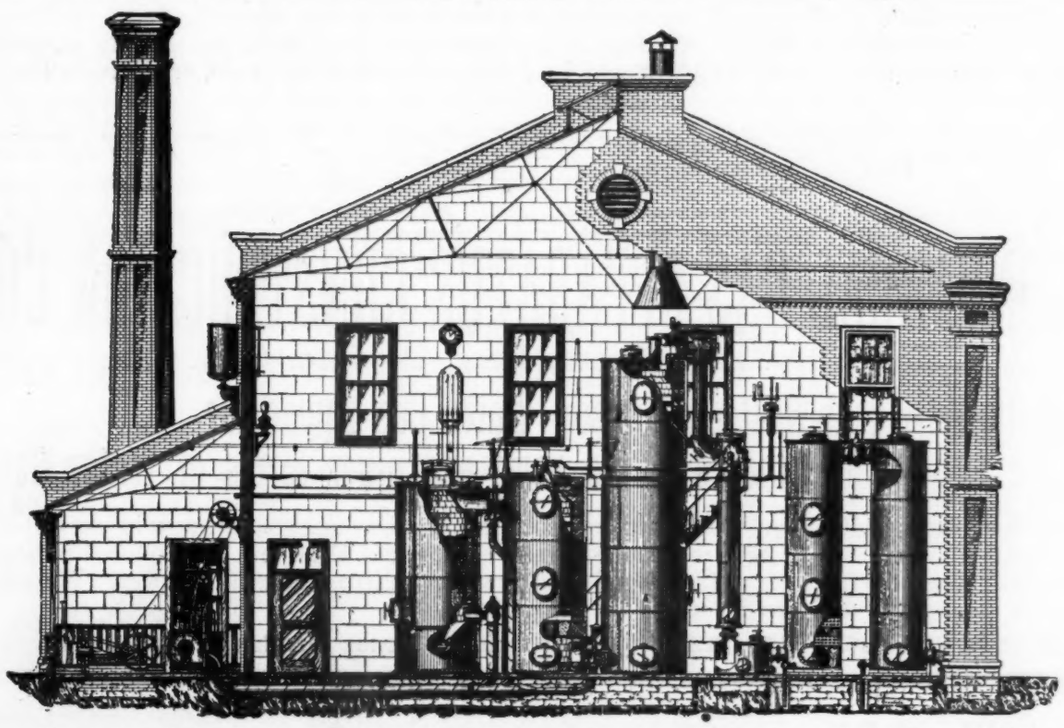

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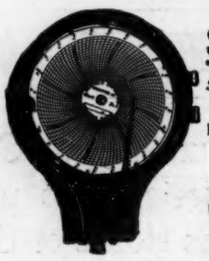

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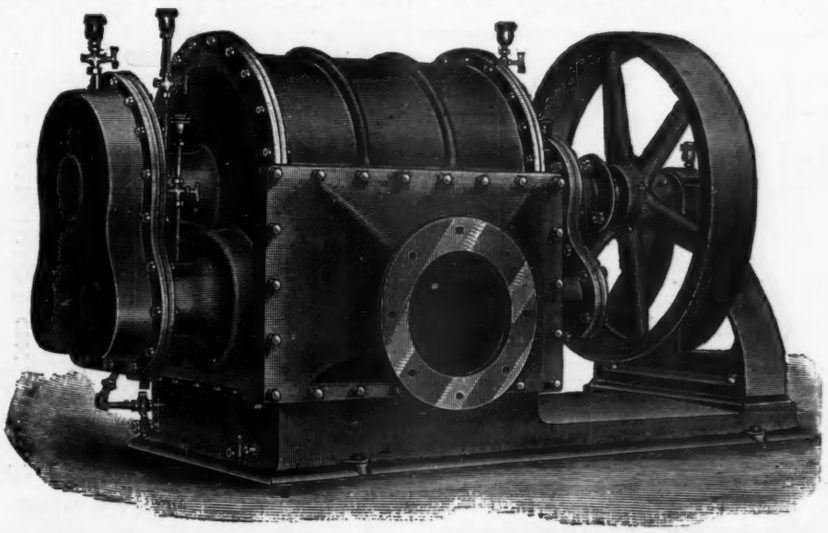

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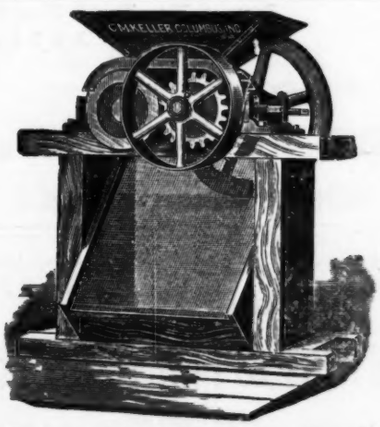

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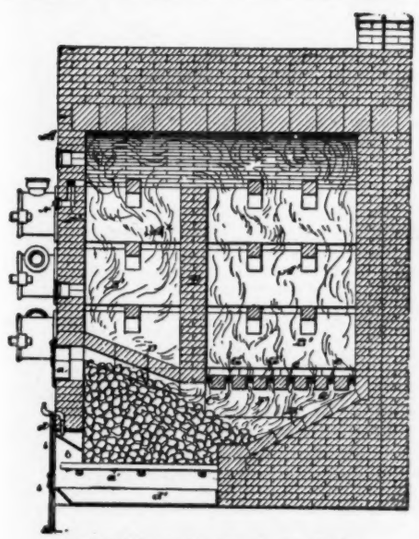

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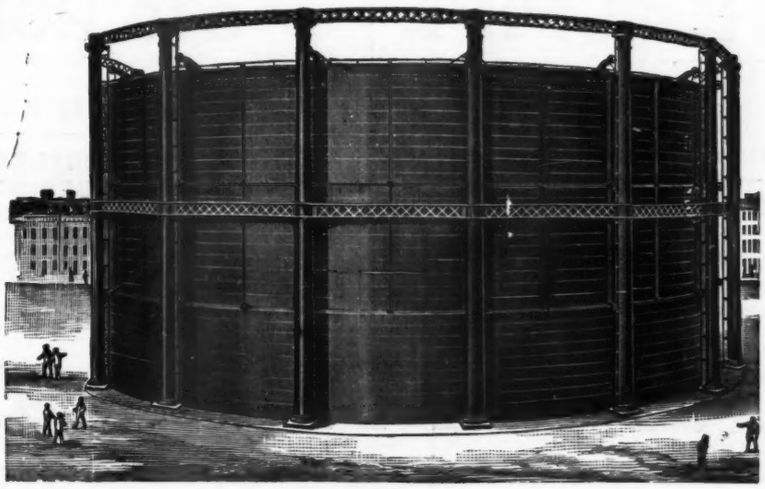

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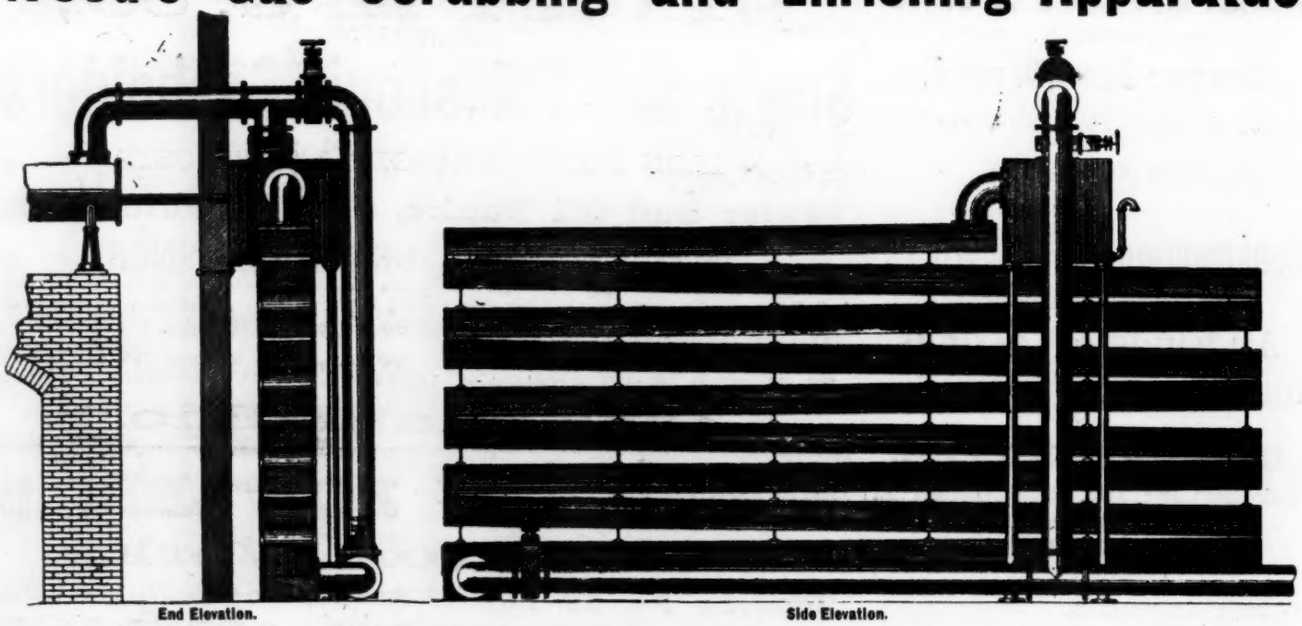

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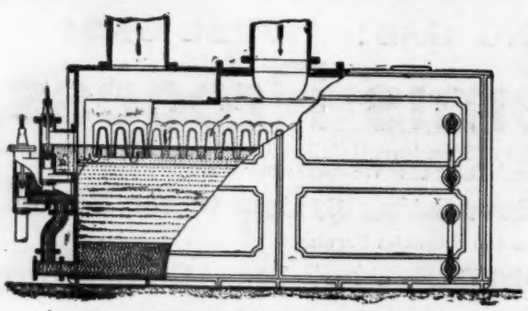

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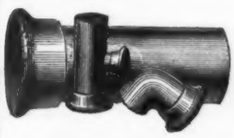

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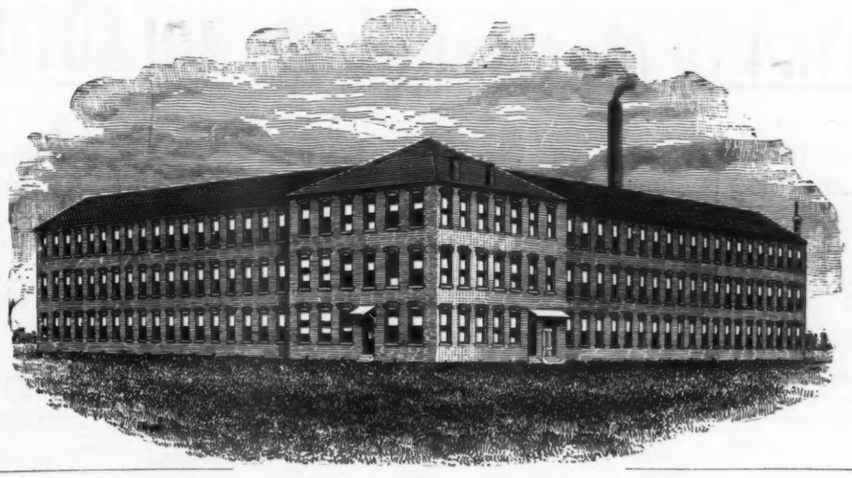

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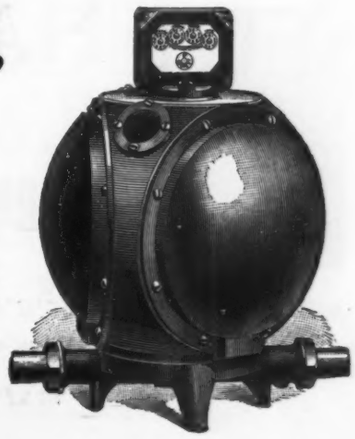

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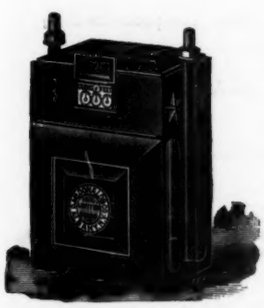

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